

# Curriculum Structure & Syllabi

(As per National Education Policy 2020)

*of*

**B. Tech.**

*in*

**Civil Engineering**

**(w.e.f. 2024-25)**

Vision

Mission

Program Educational Objectives

Program Outcomes

Overall Credit Structure

Curriculum

Syllabus



*Offered By*

**DEPARTMENT OF CIVIL ENGINEERING**

**MADAN MOHAN MALAVIYA UNIVERSITY OF TECHNOLOGY**

**(MMMUT) GORAKHPUR-273 010, UP, INDIA**

**JULY 2024**

## **ABOUT THE DEPARTMENT**

The Civil Engineering Department established in 1962, in Madan Mohan Malaviya University of Technology, Gorakhpur, is one of the oldest departments of the University, working since its inception. The department has, over the years, established its status as a centre for imparting high-quality technical education to undergraduate and post-graduate students and extending consultancy services to industries and various government departments located in the Eastern U. P. Besides the undergraduate course of B. Tech. (Civil Engineering), the department offers three regular P. G. courses viz. M. Tech. in Seismic Design and Earthquake Engineering, M. Tech. in Structural Engineering and M. Tech. in Environmental Engineering. The facilities for doctoral research are also available in the department. B. Tech. (Civil) offered by this department has been accredited by the National Board of Accreditation as per Washington Accord.

The department has experienced and highly qualified faculty members. The department capitalizes on its well-qualified and dedicated faculty towards achieving excellence in academics and research. Further, the strength of the department also lies in the strong linkages, it has with its alumni and various government/private organizations located in the region. The alumni of the department are well placed in various govt. / private organizations and are in close contact with the department. The department has been continuously interacting with various government and private organizations in the form of consultancy works, expert advice, design of projects etc. The department has latest versions of software for the learning of various areas of Civil Engineering. These software include among others ANSYS, MIDAS, STAAD PRO (with 24 modules), MATLAB, SAP 2000, OPTUM G2, CASTER etc.

With high quality faculty, staff and state of the art infrastructural facilities equipped with modern laboratories available for learning, the department also offers its expertise and other technical services in shaping various types of development projects being implemented in the fast growing part of eastern Uttar Pradesh by the State and Central government. The department is well known for its academic excellence and research contribution and provides innovations, skill development and entrepreneurship during the curriculum and extra curricular learning of students. The department has following full-fledged laboratories equipped with internet facility through LAN.

### **VISION:**

To become a premier centre of learning and research in Civil Engineering for nurturing sustainable development.

### **MISSION:**

1. To provide the quality education in the area of civil engineering to transform students into graduates with high professional values.
2. To share and disseminate expertise for use in the solution of problems faced by Civil engineering industry and by society.
3. To insure the continuous improvement in the quality of life of people in the society.
4. To conduct need based research base projects giving priority to the needs of industry.

## **Program Educational Objectives (PEO) of B. Tech in Civil Engineering**

- PEO-1 To enrich the students with state-of-the-art knowledge in the field of Civil Engineering.
- PEO-2 To keep abreast the students with the use of modern tools, equipment and software and inculcating the habit of life-long learning.
- PEO-3 To foster teamwork and professional ethics among students towards devising feasible solutions to problems and project work.

## **Program Outcome (POs)**

- PO1: Engineering Knowledge:** Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.
- PO2: Problem Analysis:** Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.
- PO3: Design/Development of Solutions:** Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.
- PO4: Conduct Investigations of Complex Problems:** Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.
- PO5: Engineering Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.
- PO6: The Engineer and The World:** Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment.
- PO7: Ethics:** Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws.
- PO8: Individual and Collaborative Team work:** Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
- PO9: Communication:** Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences
- PO10: Project Management and Finance:** Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in

multidisciplinary environments.

**PO11: Life-Long Learning:** Recognize the need for, and have the preparation and ability for  
i) independent and life-long learning ii) adaptability to new and emerging  
technologies and iii) critical thinking in the broadest context of technological change.

**Program Specific Outcome (PSO):**

- PSO -1. To identify, analyze and suggest solutions for the issues faced by the present and future generation related to Civil Engineering fields.
- PSO -2. Plan, analyze, and design infrastructural projects and its components in various areas of Civil Engineering like Structural Engineering, Geotechnical Engineering, Water Resources Engineering, Environmental Engineering, and Transportation Engineering.
- PSO -3. Execute the construction of buildings and other components of various projects in Civil engineering including its layout, management, and quality control.

**CREDIT STRUCTURE FOR B. TECH. (CIVIL ENGINEERING)**  
**(SESSION 2024-2025 AND ONWARDS)**  
**OVERALL CREDIT STRUCTURE FOR B.TECH. (CIVIL ENGINEERING)**

| <b>Credit Courses</b>                                                                                                                                                                                                                                                                                                 |                     |                                                     |                                                   |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|-----------------------------------------------------|---------------------------------------------------|
| <b>Core Courses (CC)</b>                                                                                                                                                                                                                                                                                              |                     | <b>Electives Courses (EC)</b>                       |                                                   |
| <b>Category</b>                                                                                                                                                                                                                                                                                                       | <b>Min. Credits</b> | <b>Category</b>                                     | <b>Min. Credits</b>                               |
| Basic Sciences & Maths (BSM)                                                                                                                                                                                                                                                                                          | 20                  | Professional Electives (PE)/<br>Open Electives (OE) | 36                                                |
| Engineering Fundamentals (EF)                                                                                                                                                                                                                                                                                         | 24                  |                                                     |                                                   |
| Professional Skill (PS)                                                                                                                                                                                                                                                                                               |                     |                                                     |                                                   |
| Professional Core (PC)                                                                                                                                                                                                                                                                                                | 48                  | Humanities & Social Science<br>Elective (HSSE)      | 04                                                |
| Management (M)                                                                                                                                                                                                                                                                                                        | 04                  |                                                     |                                                   |
| Humanities & Social Science (HSS)                                                                                                                                                                                                                                                                                     | 08                  |                                                     |                                                   |
| Minor Project (P)                                                                                                                                                                                                                                                                                                     | 06                  |                                                     |                                                   |
| Industrial Practice (IP) (In Industry)/ Major<br>Project (MP) (In University)                                                                                                                                                                                                                                         | 10                  |                                                     |                                                   |
| <b>Sub-total</b>                                                                                                                                                                                                                                                                                                      | <b>120</b>          | <b>Sub-total</b>                                    | <b>40</b>                                         |
| <b>Grand Total</b>                                                                                                                                                                                                                                                                                                    | <b>160</b>          |                                                     |                                                   |
| <b>Non-Credit Courses</b>                                                                                                                                                                                                                                                                                             |                     |                                                     |                                                   |
| <b>One Expert Lecture</b> per semester for students (Mandatory).<br>(BSM-1st year), (PC-2 <sup>nd</sup> Year), (T&P-3 <sup>rd</sup> Year)                                                                                                                                                                             |                     |                                                     | <b>Non-Credit</b>                                 |
| <b>Social work/Training</b> of at least 60 hours during break after first/ second semester<br>(Mandatory) (Dean of Extension, Field Outreach and Alumni Relations).                                                                                                                                                   |                     |                                                     | <b>Non-Credit</b>                                 |
| <b>Industrial Training</b> during the summer break after fourth semester (Mandatory).                                                                                                                                                                                                                                 |                     |                                                     | <b>Non-Credit</b>                                 |
| <b>One -week workshop</b> during the winter break after fifth semester on professional/<br>industry/ Social/ entrepreneurial orientation (Mandatory) (Dean of Extension, Field<br>Outreach and Alumni Relations).                                                                                                     |                     |                                                     | <b>Non-Credit</b>                                 |
| <b>Value Added Courses (VAC) / Audit Courses (AC)</b><br>Two of the Value-Added Courses / Audit Courses are compulsory.                                                                                                                                                                                               |                     |                                                     | <b>Non-Credit</b>                                 |
| <b>Extracurricular Activities Courses (ECA)</b><br>Two compulsory courses from the following S. No (ii) to (v) non-credit courses:<br>(i) Induction Program (compulsory)<br>(ii) Skill development<br>(iii) Unity and Discipline (NCC or NSS)<br>(iv) Sports, Cultural and Games<br>(v) Personality Development       |                     |                                                     | <b>Non-Credit</b>                                 |
| <b>Minor Degree (MD) from any Department and Micro Specializations (MS) within the<br/>Department</b>                                                                                                                                                                                                                 |                     |                                                     |                                                   |
| <ul style="list-style-type: none"> <li>The total number of credits for graduation will be kept to minimum 160. The additional 18-20 credits required for Minor Degree Courses.</li> <li>Micro specializations (MS) will be run by the department in order to aligned to industry careers or higher studies</li> </ul> |                     |                                                     | Offered as a<br>Professional<br>Electives<br>(PE) |

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**SEMESTER WISE CREDIT STRUCTURE FOR B. TECH. CIVIL ENGINEERING**

| Category/Semesters                                                               | I     | II | III | IV        | V     | VI        | VII       | VIII      | Total |
|----------------------------------------------------------------------------------|-------|----|-----|-----------|-------|-----------|-----------|-----------|-------|
| Basic Sciences & Maths (BSM)                                                     | 8     | 8  | 0   | 4         |       |           |           |           | 20    |
| Humanities & Social Science (HSS)                                                | 4     | 4  |     |           |       |           |           |           | 08    |
| Humanities & Social Science Elective (HSSE)                                      |       |    |     |           | 4     |           |           |           | 04    |
| Management (M)                                                                   |       |    |     |           |       | 4         |           |           | 04    |
| Engineering Fundamentals (EF)                                                    | 4     | 4  | 8   | 0         |       |           |           |           | 16    |
| Professional Skill (PS)                                                          | 4     | 4  |     |           |       |           |           |           | 08    |
| Professional Core (PC)                                                           |       |    | 12  | 12        | 12    | 12        |           |           | 48    |
| Professional Electives (PE)/<br>Open Electives (OE)                              |       |    |     | 4-8       | 28-32 |           |           |           | 36    |
| Minor Project (P)                                                                |       |    |     |           |       |           | 6         |           | 06    |
| Industrial Practice (IP) (in<br>Industry)/ Major Project (MP)<br>(In University) |       |    |     |           |       |           |           | 10        | 10    |
| Total Credit                                                                     | 20    | 20 | 20  | 20-<br>24 | 16-32 | 16-<br>32 | 6-<br>30  | 10-<br>30 | 160   |
|                                                                                  | 80-84 |    |     |           | 76-80 |           |           |           |       |
| Total Courses Offered                                                            | 05    | 05 | 05  | 05-<br>06 | 04-08 | 04-<br>08 | 00-<br>06 | 00-<br>05 | 36    |

## Curriculum for B.Tech. (Civil Engineering)

### First Year, Semester I

| S. N. | Category | Paper Code           | Subject                                          | L         | T        | P        | Credit    |
|-------|----------|----------------------|--------------------------------------------------|-----------|----------|----------|-----------|
| 1.    | BSM      | BSM-110              | Engineering Mathematics I                        | 3         | 1        | 0        | 4         |
| 2.    | BSM      | BSM-131/<br>BSM 181  | Engineering Physics                              | 3         | 0        | 2        | 4         |
| 3.    | EF       | BIT 103              | Programming in C                                 | 3         | 0        | 2        | 4         |
| 4.    | PS       | BCE 121              | Engineering Graphics                             | 2         | 0        | 4        | 4         |
| 5.    | HSS      | BHS 101 /<br>BHS 151 | Universal Human values:<br>understanding Harmony | 3         | 1        | 0        | 4         |
|       |          |                      | <b>Total</b>                                     | <b>14</b> | <b>2</b> | <b>8</b> | <b>20</b> |
| 6.    | ECA-I    |                      | <b>Induction Program</b>                         | -         | -        | -        | <b>0</b>  |

### First Year, Semester II

| S. N. | Category | Paper Code          | Subject                                             | L         | T        | P        | Credit    |
|-------|----------|---------------------|-----------------------------------------------------|-----------|----------|----------|-----------|
| 1.    | BSM      | BSM-160             | Engineering Mathematics II                          | 3         | 1        | 0        | 4         |
| 2.    | BSM      | BSM-140<br>/BSM-190 | Environmental Science and Green<br>Chemistry        | 3         | 0        | 2        | 4         |
| 3.    | EF       | BEE 107/BEE<br>157  | Basic Electrical Engineering                        | 3         | 0        | 2        | 4         |
| 4.    | PS       | BCE 161             | Building Planning and Drawing                       | 2         | 0        | 4        | 4         |
| 5.    | HSS      | BHS-102<br>/BHS-152 | Technical Writing and Professional<br>Communication | 3         | 1        | 0        | 4         |
|       |          |                     | <b>Total</b>                                        | <b>14</b> | <b>2</b> | <b>8</b> | <b>20</b> |
| 6.    | VAC/AC   | BCE-162             | Design Thinking in Civil Engineering                | 0         | 0        | 2        | 0         |
| 7.    | ECA-II   |                     |                                                     | -         | -        | -        | <b>0</b>  |

### Second Year, Semester III

| S. N. | Category | Paper Code | Subject                                                | L         | T        | P         | Credit    |
|-------|----------|------------|--------------------------------------------------------|-----------|----------|-----------|-----------|
| 1.    | EF       | BCE 210    | Civil Engineering Materials,<br>Evaluation and Testing | 3         | 0        | 2         | 4         |
| 2.    | EF       | BCE 211    | Soil Mechanics                                         | 3         | 0        | 2         | 4         |
| 3.    | PC       | BCE 212    | Structural Mechanics                                   | 3         | 0        | 2         | 4         |
| 4.    | PC       | BCE 213    | Basic Surveying                                        | 3         | 0        | 2         | 4         |
| 5.    | PC       | BCE 214    | Fluid Mechanics                                        | 3         | 0        | 2         | 4         |
|       |          |            | <b>Total</b>                                           | <b>15</b> | <b>0</b> | <b>10</b> | <b>20</b> |
| 6.    | VAC      | AUC 101    | Constitution of India                                  | 2         | 0        | 0         | 0         |
| 7.    | AC       | AUC-119    | Fundamentals of Artificial<br>Intelligence             | 2         | 0        | 0         | 0         |
| 8.    | ECA-III  |            |                                                        | -         | -        | -         | 0         |

**Second Year, Semester IV**

| S. N. | Category                                                      | Paper Code      | Subject                           | L            | T          | P           | Credit       |
|-------|---------------------------------------------------------------|-----------------|-----------------------------------|--------------|------------|-------------|--------------|
| 1.    | BSM                                                           | BSM 264         | Numerical Methods                 | 3            | 0          | 2           | 4            |
| 2.    | PC                                                            | BCE 261         | Hydraulics and Hydraulic Machines | 3            | 0          | 2           | 4            |
| 3.    | PC                                                            | BCE 262         | Structural Analysis               | 3            | 1          | 0           | 4            |
| 4.    | PC                                                            | BCE 263         | Highway Engineering               | 3            | 0          | 2           | 4            |
| 5.    | Students may choose either PE-1 or PE-2 or Both PE-1 and PE-2 |                 |                                   |              |            |             |              |
| 6.    | PE                                                            |                 | PE1                               | 3            | 1/0        | 0/2         | 4            |
| 7.    | PE                                                            |                 | PE2                               | 3            | 1/0        | 0/2         | 4            |
|       |                                                               |                 | <b>Total</b>                      | <b>15-18</b> | <b>1-3</b> | <b>6-10</b> | <b>20-24</b> |
| 8.    | VAC/AC                                                        | AUC 102-AUC 115 |                                   | 2            | 0          | 0           | 0            |
| 8.    | ECA - IV                                                      |                 |                                   | -            | -          | -           | 0            |

**Third Year, Semester V**

| S. N. | Category                                                                                        | Paper Code  | Subject                              | L            | T          | P          | Credit       |
|-------|-------------------------------------------------------------------------------------------------|-------------|--------------------------------------|--------------|------------|------------|--------------|
| 1     | PC                                                                                              | BCE 305     | Foundation Engineering               | 3            | 1          | 0          | 4            |
| 2     | PC                                                                                              | BCE 306     | Water and Wastewater Engineering     | 3            | 0          | 2          | 4            |
| 3     | PC                                                                                              | BCE 307     | Design of Concrete Structures        | 3            | 0          | 2          | 4            |
| 4     | HSSE                                                                                            | BHS 303/353 | Industrial/Organizational Psychology | 3            | 1          | 0          | 4            |
|       | Student may choose maximum up to 04 courses from the list of PE category courses (PE-1 to PE-9) |             |                                      |              |            |            |              |
| 5     | PE                                                                                              |             | PE1                                  | 3            | 1/0        | 0/2        | 4            |
| 6     | PE                                                                                              |             | PE2                                  | 3            | 1/0        | 0/2        | 4            |
| 7     | PE                                                                                              |             | PE3                                  | 3            | 1/0        | 0/2        | 4            |
| 8     | PE                                                                                              |             | PE4                                  | 3            | 1/0        | 0/2        | 4            |
| 9     | PE                                                                                              |             | PE5                                  | 3            | 1/0        | 0/2        | 4            |
| 10    | PE                                                                                              |             | PE6                                  | 3            | 1/0        | 0/2        | 4            |
| 11    | PE                                                                                              |             | PE7                                  | 3            | 1/0        | 0/2        | 4            |
| 12    | PE                                                                                              |             | PE8                                  | 3            | 1/0        | 0/2        | 4            |
| 13    | PE                                                                                              |             | PE9                                  | 3            | 1/0        | 0/2        | 4            |
|       |                                                                                                 |             | <b>Total</b>                         | <b>12-24</b> | <b>2-6</b> | <b>4-8</b> | <b>16-32</b> |
| 14    | ECA-V                                                                                           |             |                                      | -            | -          | -          | 0            |

**Third Year, Semester VI**

| S. N. | Category | Paper Code | Subject                                | L | T | P | Credit |
|-------|----------|------------|----------------------------------------|---|---|---|--------|
| 1.    | PC       | BCE 354    | Design of Airport, Docks and Harbor    | 3 | 1 | 0 | 4      |
| 2.    | PC       | BCE 355    | Construction Technology and Management | 3 | 1 | 0 | 4      |
| 3.    | PC       | BCE 356    | Water Resources Engineering            | 3 | 1 | 0 | 4      |



|     |                                                                                                 |             |                                     |              |            |             |              |
|-----|-------------------------------------------------------------------------------------------------|-------------|-------------------------------------|--------------|------------|-------------|--------------|
| 4.  | M                                                                                               | BMS 301/351 | Principles of Industrial Management | 3            | 1          | 0           | 4            |
| 5.  | P                                                                                               | BCE 371     | Minor Project I                     | 0            | 0          | 0           | 0            |
|     | Student may choose maximum up to 04 courses from the list of PE category courses (PE-1 to PE-9) |             |                                     |              |            |             |              |
| 6.  | PE                                                                                              |             | PE1                                 | 3            | 1/0        | 0/2         | 4            |
| 7.  | PE                                                                                              |             | PE2                                 | 3            | 1/0        | 0/2         | 4            |
| 8.  | PE                                                                                              |             | PE3                                 | 3            | 1/0        | 0/2         | 4            |
| 9.  | PE                                                                                              |             | PE4                                 | 3            | 1/0        | 0/2         | 4            |
| 10. | PE                                                                                              |             | PE5                                 | 3            | 1/0        | 0/2         | 4            |
| 11. | PE                                                                                              |             | PE6                                 | 3            | 1/0        | 0/2         | 4            |
| 12. | PE                                                                                              |             | PE7                                 | 3            | 1/0        | 0/2         | 4            |
| 13. | PE                                                                                              |             | PE8                                 | 3            | 1/0        | 0/2         | 4            |
| 14. | PE                                                                                              |             | PE9                                 | 3            | 1/0        | 0/2         | 4            |
|     |                                                                                                 |             | <b>Total</b>                        | <b>15-27</b> | <b>4-8</b> | <b>2-10</b> | <b>16-32</b> |
| 15. | ECA VI                                                                                          |             |                                     | -            | -          | -           | <b>0</b>     |

#### Final Year, Semester VII

| S. N. | Category                                                                                        | Paper Code | Subject           | L           | T          | P            | Credit      |
|-------|-------------------------------------------------------------------------------------------------|------------|-------------------|-------------|------------|--------------|-------------|
| 1     | P                                                                                               | BCE 441    | Minor Project- II | 0           | 0          | 12           | 6           |
|       | Student may choose maximum up to 06 courses from the list of PE category courses (PE-1 to PE-9) |            |                   |             |            |              |             |
| 3     | PE                                                                                              |            | PE1               | 3           | 1/0        | 0/2          | 4           |
| 4     | PE                                                                                              |            | PE2               | 3           | 1/0        | 0/2          | 4           |
| 5     | PE                                                                                              |            | PE3               | 3           | 1/0        | 0/2          | 4           |
| 6     | PE                                                                                              |            | PE4               | 3           | 1/0        | 0/2          | 4           |
| 7     | PE                                                                                              |            | PE5               | 3           | 1/0        | 0/2          | 4           |
| 8     | PE                                                                                              |            | PE6               | 3           | 1/0        | 0/2          | 4           |
| 9     | PE                                                                                              |            | PE7               | 3           | 1/0        | 0/2          | 4           |
| 10    | PE                                                                                              |            | PE8               | 3           | 1/0        | 0/2          | 4           |
| 11    | PE                                                                                              |            | PE9               | 3           | 1/0        | 0/2          | 4           |
|       |                                                                                                 |            | <b>Total</b>      | <b>0-18</b> | <b>0-6</b> | <b>12-24</b> | <b>6-30</b> |
| 12    | ECA VII                                                                                         |            |                   | -           | -          | -            | <b>0</b>    |

#### Final Year, Semester VIII

| S. N. | Category                                                                                        | Paper Code | Subject                                | L | T   | P   | Credit |
|-------|-------------------------------------------------------------------------------------------------|------------|----------------------------------------|---|-----|-----|--------|
| 1.    | IP                                                                                              | ICE 490    | Industrial Practice (IP) (in Industry) | 0 | 0   | 20  | 10     |
|       | <b>Without IP</b>                                                                               |            |                                        |   |     |     |        |
| 2.    | MP                                                                                              | ICE 481    | Major Project (MP) (in University)     | 0 | 0   | 20  | 10     |
|       | Student may choose maximum up to 05 courses from the list of PE category courses (PE-1 to PE-9) |            |                                        |   |     |     |        |
| 3.    | PE                                                                                              |            | PE1                                    | 3 | 1/0 | 0/2 | 4      |
| 4.    | PE                                                                                              |            | PE2                                    | 3 | 1/0 | 0/2 | 4      |

|     |    |  |              |             |            |              |              |
|-----|----|--|--------------|-------------|------------|--------------|--------------|
| 5.  | PE |  | PE3          | 3           | 1/0        | 0/2          | 4            |
| 6.  | PE |  | PE4          | 3           | 1/0        | 0/2          | 4            |
| 7.  | PE |  | PE5          | 3           | 1/0        | 0/2          | 4            |
| 8.  | PE |  | PE6          | 3           | 1/0        | 0/2          | 4            |
| 9.  | PE |  | PE7          | 3           | 1/0        | 0/2          | 4            |
| 10. | PE |  | PE8          | 3           | 1/0        | 0/2          | 4            |
| 11. | PE |  | PE9          | 3           | 1/0        | 0/2          | 4            |
|     |    |  | <b>Total</b> | <b>0-15</b> | <b>0-5</b> | <b>20-30</b> | <b>10-30</b> |

### **List of Professional Electives**

| <b>Electives under PE1</b> |                                                        | <b>Electives under PE2</b> |                                          |
|----------------------------|--------------------------------------------------------|----------------------------|------------------------------------------|
| ECE 101                    | Matrix Method of Analysis                              | ECE 201                    | Prestressed Concrete                     |
| ECE 102                    | Geotechnical Investigations and Field Testing of Soils | ECE 202                    | Rock Mechanics                           |
| ECE 103                    | Global Warming and Climate Change                      | ECE 203                    | Environmental Chemistry and Microbiology |
| ECE 104                    | Principles of Highway Engineering                      | ECE 204                    | Traffic Engineering                      |
| ECE 105                    | Engineering Hydrology                                  |                            |                                          |
| ECE 106                    | Geographic Information System                          |                            |                                          |

| <b>Electives under PE3</b> |                                     | <b>Electives under PE4</b> |                              |
|----------------------------|-------------------------------------|----------------------------|------------------------------|
| ECE 301                    | Structural Dynamics                 | ECE 401                    | Design of Bridges            |
| ECE 302                    | Ground Improvement Techniques       | ECE 402                    | Geosynthetics Engineering    |
| ECE 303                    | Environmental Planning & Management | ECE 403                    | Disaster Management          |
| ECE 304                    | Railway and Airport Engineering     | ECE 404                    | Pavement Analysis and Design |
| ECE 305                    | Soil Water Conservation             | ECE 405                    | Advanced Fluid Mechanics     |
| ECE 306                    | Principles of Remote Sensing        |                            |                              |

| <b>Electives under PE5</b> |                                       | <b>Electives under PE6</b> |                                                   |
|----------------------------|---------------------------------------|----------------------------|---------------------------------------------------|
| ECE 501                    | Repair and Retrofitting of Structures | ECE 601                    | Steel Structures                                  |
| ECE 502                    | Geotechnical Earthquake Engineering   | ECE 602                    | Tunnel Engineering                                |
| ECE 503                    | Environmental Laws and Policy         | ECE 603                    | Analysis and Design of Water Distribution Systems |
| ECE 504                    | Highway Geometric Design              | ECE 604                    | Urban Transportation System Planning              |
| ECE 505                    | Open Channel Hydraulics               | ECE 605                    | Analysis and Design of Hydraulic Structures       |
| ECE 506                    | Groundwater Hydrology                 |                            |                                                   |

| <b>Electives under PE7</b> |                                      | <b>Electives under PE8</b> |                                 |
|----------------------------|--------------------------------------|----------------------------|---------------------------------|
| ECE 701                    | Advance Concrete Technology          | ECE 801                    | Design of Masonry Structures    |
| ECE 702                    | Earth and Earth Retaining Structures | ECE 802                    | Advanced Foundation Engineering |

|         |                                                      |         |                                                 |
|---------|------------------------------------------------------|---------|-------------------------------------------------|
| ECE 703 | Environmental Change & Sustainable Development       | ECE 803 | Environmental Impact Assessment                 |
| ECE 704 | Intelligent Transportation System                    | ECE 804 | Planning Design and Construction of Rural Roads |
| ECE 705 | Water Resources Management                           | ECE 805 | Urban Stormwater Management                     |
| ECE 706 | Application of Machine Learning in Civil Engineering |         |                                                 |

| Electives under PE9 |                                                     |
|---------------------|-----------------------------------------------------|
| ECE 901             | Seismic Design of Structures                        |
| ECE 902             | Foundation on Expansive Soils                       |
| ECE 903             | Environmental Data Science and Analytics            |
| ECE 904             | Pavement Evaluation, Rehabilitation and Maintenance |
| ECE 905             | Geoinformatics for Water Resources                  |

### List of Extra Curricular Activity (ECA) Courses

| ECA-II |                      |          |                              |              |            |        |
|--------|----------------------|----------|------------------------------|--------------|------------|--------|
| S. No. | Branch               | Category | Subject Name                 | Subject Code | Hours/Week | Credit |
| 1.     | Open to all Branches | ECA      | Skill Development-I          | ECA-151      | 2          | 0      |
| 2.     | Open to all Branches | ECA      | Unity and Discipline (NCC)-I | ECA-171      | 2          | 0      |
| 3.     | Open to all Branches | ECA      | Unity and Discipline (NSS)-I | ECA-172      | 2          | 0      |
| 4.     | Open to all Branches | ECA      | Games & Sports-I             | ECA-181      | 2          | 0      |
| 5.     | Open to all Branches | ECA      | Cultural, Art & Literary-I   | ECA-182      | 2          | 0      |

### List of Value-Added Courses (VAC)/Audit Courses (AC)

| S.No. | Subjects                                        | Codes  |
|-------|-------------------------------------------------|--------|
| 1.    | Constitution of India                           | AUC101 |
| 2.    | Indian Culture and Heritage                     | AUC102 |
| 3.    | Indian Architecture                             | AUC103 |
| 4.    | Indian Festivals                                | AUC104 |
| 5.    | Vedic Mathematics                               | AUC105 |
| 6.    | Astronomy                                       | AUC106 |
| 7.    | Arts of India                                   | AUC107 |
| 8.    | Intellectual Property Rights                    | AUC108 |
| 9.    | Human Rights                                    | AUC109 |
| 10.   | Logical Research                                | AUC110 |
| 11.   | Professional Ethics                             | AUC111 |
| 12.   | Environmental Law                               | AUC112 |
| 13.   | Health Law                                      | AUC113 |
| 14.   | National Cadet Corps                            | AUC114 |
| 15.   | Basics of Human Health and Preventive Medicines | AUC115 |

|     |                                                                                        |        |
|-----|----------------------------------------------------------------------------------------|--------|
| 16. | Constitution Of India And Environmental Governance: Administration And Adjudication    | AUC116 |
| 17. | Directive Principles Of State Policy And Fundamental Duties: Constitutional Imperative | AUC117 |
| 18. | Introduction To Intellectual Property To Engineers And Technologists                   | AUC118 |
| 19. | Fundamentals of Artificial Intelligence                                                | AUC119 |
| 20. | Indian Knowledge Through Classical Languages                                           | IKS101 |
| 21. | Indian Knowledge System: Concepts And Applications In Science                          | IKS102 |
| 22. | Indian Knowledge System: Concepts And Applications In Engineering                      | IKS103 |
| 23. | Indian Knowledge System                                                                | IKS104 |

### **SKILLS ENHANCEMENT COURSES FOR EXIT (CIVIL ENGINEERING):**

2-Months internship for 6-Credits OR Two courses mentioned below of 4 to 6 credits.

#### **A. After First Year: UG Certificate (Engg.).**

The candidate should pass the following two additional courses (ITI Level) **OR** any two suitable skill-based courses to qualify for **UG Certificate (Engg.).**

| S. N. | Category          | Paper Code | Subject                   | L | T | P | Credit |
|-------|-------------------|------------|---------------------------|---|---|---|--------|
| 1.    | Skill Enhancement | BCE 163    | Plumbing and Sanitation   | 2 | 0 | 2 | 3      |
| 2.    | Skill Enhancement | BCE 164    | Computer Aided Drafting   | 2 | 0 | 2 | 3      |
| 3.    | Skill Enhancement | BCE 165    | Carpentry and Fabrication | 2 | 0 | 2 | 3      |

**Or** Equivalent skills enhancement courses from MOOC/SWAYAM

#### **B. After Second Year: UG Diploma (Engg.).**

The candidate should pass the following two additional courses **OR** any two suitable skill-based courses to qualify for **UG Diploma (Engg.).**

| S. N. | Category          | Paper Code | Subject                                           | L | T | P | Credit |
|-------|-------------------|------------|---------------------------------------------------|---|---|---|--------|
| 1.    | Skill Enhancement | BCE 264    | Introduction to Remote Sensing and GIS            | 2 | 0 | 2 | 3      |
| 2.    | Skill Enhancement | BCE 265    | Analysis and Design of Water Distribution Systems | 2 | 0 | 2 | 3      |
| 3.    | Skill Enhancement | BCE 266    | Geotechnical Exploration and Instrumentation      | 2 | 0 | 2 | 3      |

**Or** Equivalent skills enhancement courses from MOOC/SWAYAM

#### **C. After Third Year: B. Voc. (Engg.)**

The candidate should pass following two additional courses (Degree Level) **Or** any two suitable skill based courses to qualify for **B. Voc. (Engg.)**

| S. N. | Category          | Paper Code | Subject                                          | L | T | P | Credit |
|-------|-------------------|------------|--------------------------------------------------|---|---|---|--------|
| 1.    | Skill Enhancement | BCE 357    | Pavement Design Using Software                   | 2 | 0 | 2 | 3      |
| 2.    | Skill Enhancement | BCE 358    | Software Application for Building Design         | 2 | 0 | 2 | 3      |
| 3.    | Skill Enhancement | BCE 359    | Software Application in Geotechnical Engineering | 2 | 0 | 2 | 3      |

**Or** Equivalent skills enhancement courses from MOOC/SWAYAM

## SYLLABI

### Semester-I

|                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>BSM 110</b>                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>ENGINEERING MATHEMATICS I</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Course category</b>                                                                                                                                                                                                                                                                                                                                                                                                                       | :                                | Basic Sciences & Maths (BSM)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Pre-requisite Subject</b>                                                                                                                                                                                                                                                                                                                                                                                                                 | :                                | NIL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Contact hours/week</b>                                                                                                                                                                                                                                                                                                                                                                                                                    | :                                | Lecture: 3, Tutorial: 1, Practical: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Number of Credits</b>                                                                                                                                                                                                                                                                                                                                                                                                                     | :                                | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Course Assessment methods</b>                                                                                                                                                                                                                                                                                                                                                                                                             | :                                | Continuous assessment through tutorials, attendance, home assignments, quizzes and one Minor tests and One Major Theory Examination                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Course Objectives</b>                                                                                                                                                                                                                                                                                                                                                                                                                     | :                                | The course is aimed to develop the basic mathematical skills of engineering students that are imperative for effective understanding of engineering subjects.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Course Outcomes</b>                                                                                                                                                                                                                                                                                                                                                                                                                       | :                                | <p>The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course.</p> <ol style="list-style-type: none"> <li>1. Solve linear system of equations using matrix algebra.</li> <li>2. Know about qualitative applications of Gauss, Stoke's and Green's theorem.</li> <li>3. Use of basic differential operators in various engineering problems.</li> <li>4. Understand the concepts of limit theory and nth order differential equations and their applications to our daily life</li> <li>5. To know the applications of double and triple integration in finding the area and volume.</li> <li>6. To inculcate the habit of mathematical thinking and lifelong learning.</li> </ol> |
| <b>Topics Covered</b>                                                                                                                                                                                                                                                                                                                                                                                                                        |                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>UNIT-I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                |                                  | 9                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Differential Calculus:</b> Limit, Continuity and Differentiability, Mean value theorems. Leibnitz theorem, Partial derivatives, Euler's theorem for homogenous function, Total derivative, Change of variable. Taylor's and Maclaurin's theorem. Expansion of function of two variables, Jacobian, Extrema of function of several variables.                                                                                              |                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>UNIT-II</b>                                                                                                                                                                                                                                                                                                                                                                                                                               |                                  | 9                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Linear Algebra:</b> Symmetric, Skew-symmetric matrices, Hermitian, Skew Hermitian Matrices, orthogonal and unitary matrices and basic properties, linear independence and dependence of vectors, Rank of Matrix, Inverse of a Matrix, Elementary transformation, Consistency of linear system of equations and their solution, Characteristic equation, Eigenvalues, Eigen-vectors, Cayley-Hamilton theorem, Diagonalization of matrices. |                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>UNIT-III</b>                                                                                                                                                                                                                                                                                                                                                                                                                              |                                  | 9                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Multiple Integrals:</b> Double and triple integrals, change of order of integration, change of variables. Application of multiple integral to surface area and volume. Beta and Gamma functions, Dirichlet integral.                                                                                                                                                                                                                      |                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>UNIT-IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                               |                                  | 9                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Vector Calculus:</b> Gradient, Divergence and Curl. Directional derivatives, line, surface and volume integrals. Applications of Green's, Stoke's and Gauss divergence theorems (without Proofs).                                                                                                                                                                                                                                         |                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Books &amp; References</b>                                                                                                                                                                                                                                                                                                                                                                                                                |                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <ol style="list-style-type: none"> <li>1. B.S. Grewal: Higher Engineering Mathematics; Khanna Publishers</li> <li>2. Erwin kreyszig: Advanced Engineering Mathematics, John Wiley &amp; Sons.</li> <li>3. R. K. Jain and Iyenger: Advanced Engineering Mathematics, Narosa Publications.</li> <li>4. B.V. Ramana: Higher Engineering Mathematics, Tata Mc. Graw Hill Education Pvt. Ltd.,</li> </ol>                                         |                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

|                              |                            |                                      |
|------------------------------|----------------------------|--------------------------------------|
| <b>BSM 131/181</b>           | <b>ENGINEERING PHYSICS</b> |                                      |
| <b>Course category</b>       | :                          | Basic Sciences and Maths (BSM)       |
| <b>Pre-requisite Subject</b> | :                          | Physics at 12 <sup>th</sup> Standard |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Contact hours/week</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | : | Lecture: 3, Tutorial: 0 , Practical: 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Number of Credits</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | : | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Course Assessment methods</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | : | Continuous assessment through tutorials, attendance, home assignments, quizzes and one Minor tests and One Major Theory Examination                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Course Objectives</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | : | Understanding of the principles and concept of Optics, Quantum Mechanics, Fiber Optics, Electrodynamics and Physics of Advanced Materials.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Course Outcomes</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | : | <p>The students are expected to be able to demonstrate the following knowledge, skills, and attributes after completing this course.</p> <ol style="list-style-type: none"> <li>1. Understand the basics principles of Optics and its applications in Engineering and Technology.</li> <li>2. Compare and understand the uses of various lasers in different fields of Engineering.</li> <li>3. Know the knowledge of Optical Fibre and their applications in Photonics.</li> <li>4. Understand the principles of Quantum Mechanics and their applications in Engineering and Technology.</li> <li>5. Know the principles of Electrodynamics and their applications in Engineering and Technology.</li> <li>6. Understand the basic properties of advanced materials and their engineering applications.</li> </ol> |
| <b>Topics Covered</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>UNIT-I: Optics</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <p><b>Interference:</b> Interference of light, Interference in thin films, Newton's rings. Refractive index and wavelength determination.</p> <p><b>Diffraction:</b> Fresnel and Fraunhofer class of diffraction. Resultant of n-harmonic waves, single, double and N- slit diffraction, Diffraction grating, Grating spectra, Dispersive power.</p> <p><b>Polarization:</b> Phenomena of double refraction, Nicol prism, Production and analysis of plane, circular and elliptical polarized light, Retardation Plate, Polarimeter.</p> <p><b>Laser:</b> Spontaneous and stimulated emission of radiation, Population inversion, Concept of 3 and 4 level Laser, Construction and working of Ruby, He-Ne lasers, and laser applications.</p> |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>UNIT – II: Quantum Mechanics and Fiber Optics</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <p><b>Quantum Mechanics:</b> de Broglie waves, Davisson-Germer experiment, Concept of Phase and Group velocities, Uncertainty principle and its applications, Derivation of time independent and time dependent Schrodinger wave equations. Postulates of quantum mechanics, Significance of wave function, Application of Schrodinger wave equation for a particle in one dimensional infinite potential well.</p> <p><b>Fiber Optics:</b> Fundamentals of optical fiber, Acceptance angle and cone, Numerical aperture, Single and Multi-Mode Fibers, Step index and graded index fiber, Propagation Mechanism in optical fibers.</p>                                                                                                       |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>UNIT-III: Electrodynamics</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <p>Scalar and Vector fields, Gradient, Divergence and curl, Concept of displacement current, Maxwell's equation in differential and integral forms, Physical significance of each equation.</p> <p>Maxwell's equation in free space, Velocity of electromagnetic wave, Transverse nature of the electromagnetic wave, Poynting vector, Maxwell's equations in dielectric and conducting medium, and skin depth.</p>                                                                                                                                                                                                                                                                                                                           |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>UNIT-IV: Physics of Advanced Materials</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <p>Concept of energy bands in solids, Semiconducting materials, Concept of direct and indirect band gap in semiconductors, Carrier concentration and conductivity in semiconductors, Optoelectronic Materials, Superconducting Materials, Temperature dependence of resistivity in superconducting materials, Effect of magnetic field (Meissner effect), Type I and Type II superconductors, London Equations, BCS theory (Qualitative), Introduction of nanoscience, Nanotechnology and its applications.</p>                                                                                                                                                                                                                               |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

**EXPERIMENTS**

1. To determine the specific resistance of a given wire using Carrey Foster's Bridge.
2. To determine the wavelength of sodium light using Newton's Ring experiment.
2. To determine the wavelength of spectral lines of white light using plane diffraction grating.
3. To determine the specific rotation of cane sugar solution using polarimeter.
4. To study the variation of magnetic field along the axis of current carrying circular coil.
5. To study the Hall's effect and to determine Hall coefficient in n type Germanium.
6. To study the energy band gap of Germanium using four probe method.
7. To determine the height of Tower by Sextant.

**Books & References**

1. Optics- Ajoy Ghatak, Tata McGraw-Hill
2. Optics- N. Subrahmanyam, Brij Lal, M.N. Avadhanulu, S. Chand
3. Quantum Mechanics: Theory and Applications- Ajoy Ghatak, Tata McGraw-Hill
4. Fiber optics and laser Principles and Applications-Anuradha De, New Age International
5. Optical Fibers and its application as sensors by R. K. Shukla, New Age International.
6. Introduction to Electrodynamics by David J. Griffiths, Pearson
7. Physics of Semiconductor Devices, by S. M. Sze, Wiley
8. Concepts of Modern Physics by Arthur Beiser, Tata McGraw Hill.
9. Introduction to Solid State Physics by C. Kittel, Wiley.
10. Engineering Physics by B. K. Pandey and S. Chaturvedi, 3e Cengage Learning Pvt. Limited, India.
11. Engineering Physics by H. K. Malik and A. Singh Tata McGraw Hill.
12. Advanced Practical Physics Vol. I and Vol. II by D. K. Dwivedi, Victorius Publishers, New Delhi.

|                           |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |   |
|---------------------------|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
| BIT 103                   |   | PROGRAMMING IN C                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |   |
| Course category           | : | Engineering Fundamentals (EF)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |   |
| Pre-requisite Subject     | : | NIL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |   |
| Contact hours/week        | : | Lecture: 3, Tutorial: 0, Practical:2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |   |
| Number of Credits         | : | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |   |
| Course Assessment methods | : | Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce, Minor test and Major Theory Examination                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |   |
| Course Objectives         | : | Students will gain an understanding of the fundamentals of computers and programming. The objective is to prepare them for various dimensions of C Programming language.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |   |
| Course Outcomes           | : | The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course<br><div><div>1. Describing the basics of terminologies used in computer programming.</div><div>2. Practicing C language programming by writing, compiling and debugging the code.</div><div>3. Designing programs involving simple statements, conditional statements, iterative statements, array, strings, functions, recursion and structure.</div><div>4. Discussing the dynamic memory allocations and use of the pointers.</div><div>5. Applying basic operations on files through programs.</div><div>6. Studying and implementing the codes using macros, pre-processor directives and command line arguments</div></div> |   |
| Topics Covered            |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |   |
| UNIT I                    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 9 |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |          |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| <b>Basics of Computers and Programming:</b> Functional diagram of computer; Language Processors; Approaches to problem solving, Concept of algorithm and flow charts. <b>Simple Statements:</b> Data types; Tokens and its types; Variable declaration and initialization; User defined type declaration: type def, enum; Comments; Format specifiers; Standard I/O: taking input and displaying output; <b>Operators:</b> types, precedence and associativity; Expressions; Type conversion, Cshort-hands.                                                                                                                                                                                                                     |          |
| <b>UNIT II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>9</b> |
| <b>Conditional Statements:</b> Simple if, if-else, nested if-else, else-if ladder, switch statements, nested switch, advantages of switch over nested if, restrictions on switch values. <b>Iterative Statements:</b> Concepts of entry and exit controlled loops; Uses of for, while and do while loops; Nested Loops; Printing various patterns using nested loops; Using break, continue and goto statements.                                                                                                                                                                                                                                                                                                                |          |
| <b>UNIT III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>9</b> |
| <b>Arrays:</b> Single-dimensional, multi-dimensional array and their applications; declaration and manipulation of arrays; strings and string handling functions. <b>Pointers:</b> Pointer and address arithmetic; dereferencing; pointers and arrays; dynamic memory allocation and de-allocation. <b>Functions:</b> Function prototype; Arguments and its types: actual, formal and default arguments; Scope of a variable; Argument passing methods; Passing pointer as the function argument; Recursion: types, advantages and disadvantages; Storage class specifies; Character test functions.                                                                                                                            |          |
| <b>UNIT IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>9</b> |
| <b>Structure:</b> Declaring and defining structures; Array within structure; Array of structure; Defining and using some data structures: Stack, Queue, and Linked lists. <b>File Handling:</b> Types of files; Text files and different operations on text files, opening a file, closing a file; Data structure of a file; EOF; I/O operations on files; Random access to the files. <b>Standard C Pre-processors &amp; C Library:</b> Pre-processor, Directives, Macro, Macro substitution; Conditional Compilation; Command Line Arguments; Standard C Library.                                                                                                                                                             |          |
| <b>EXPERIMENTS</b><br>Implementing programs in following categories using programming language ‘C’:<br><ol style="list-style-type: none"> <li>1. Programs of simple statements, conditional statements, and iterative statements with the applications.</li> <li>2. Programs of single and multi-dimensional arrays and their applications.</li> <li>3. Programs of strings and the applications</li> <li>4. Programs of pointer and the applications</li> <li>5. Programs of function and the applications</li> <li>6. Programs of structure and the applications</li> <li>7. Codes of file handling and management</li> <li>8. Codes with Pre-processor, Macro, Conditional Compilation and Command Line Arguments</li> </ol> |          |
| <b>Textbooks</b><br><ol style="list-style-type: none"> <li>1. Brian W. Kernighan and Dennis M. Ritchie, “The C programming language”, Pearson</li> <li>2. E. Balagurusamy, “Programming in ANSI C”, McGraw Hill Education</li> <li>3. Yashavant Kanetkar, “Let Us C”, bpb publication</li> <li>4. Jeri R. Hanly, Elliot B. Koffman, “Problem Solving and Program Design in C”, Pearson</li> <li>5. Herbert Schildt, “C: The Complete Reference”, McGraw Hill Education</li> </ol>                                                                                                                                                                                                                                               |          |

| <b>BCE 121</b>                   |   | <b>ENGINEERING GRAPHICS</b>                                                                                                                                                    |
|----------------------------------|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course category</b>           | : | Professional Skill (PS)                                                                                                                                                        |
| <b>Pre-requisite Subject</b>     | : | NIL                                                                                                                                                                            |
| <b>Contact hours/week</b>        | : | Lecture : 2, Tutorial : 0 , Practical: 4                                                                                                                                       |
| <b>Number of Credits</b>         | : | 4                                                                                                                                                                              |
| <b>Course Assessment methods</b> | : | Continuous assessment through attendance, home assignments, quizzes, practical work, record, viva voce, one minor tests, One Major Theory Exam and major Practical Examination |



|                          |   |                                                                                                                                                                                                                                                                                                                                                                                                                  |
|--------------------------|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course Objectives</b> | : | This course aims at the following educational objectives: Comprehend general projection theory, with emphasis on orthographic projection to represent three-dimensional objects in two-dimensional views (principal, auxiliary, sections). Dimension and annotate two-dimensional engineering drawings.                                                                                                          |
| <b>Course Outcomes</b>   | : | The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course                                                                                                                                                                                                                                                                                   |
|                          |   | 1.How Engineering Drawing helps to sketch the imagination?<br>2.Able to effectively practice the different scales for drawings.<br>3.Effectively analyze the geometrical shapes and to be able to draw.<br>4.Know about out solids and discuss about their classification.<br>5.How to implement the different views for a solid placed in 3d space.<br>6.Construction of the object from different perspective. |

### Topics Covered

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |          |
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| <b>UNIT-I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>6</b> |
| <b>Conic Sections and Orthographic Projections Introduction</b><br>Introduction to Engineering Drawing covering, Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales.<br><b>Orthographic Projections</b><br>Orthographic Projections covering Principles of Orthographic Projections- Conventions Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Plane |          |
| <b>UNIT-II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>6</b> |
| <b>Projection of Regular Solids</b><br>Projections of Regular Solids covering those inclined to both the Planes- Auxiliary Views                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |          |
| <b>UNIT-III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>6</b> |
| <b>Sections and Sectional Views of Right Angular Solids</b><br>Sections and Sectional Views of Right Angular Solids covering, Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone                                                                                                                                                                                                                                                                                                                                                                     |          |
| <b>UNIT-IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>6</b> |
| <b>Isometric Projections</b><br>Isometric Projections covering, Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions. Overview of computer graphics, demonstrating knowledge of the theory of CAD software.                                                                                                                                                                                                                                                |          |
| <b>List of Experiments</b><br>1 To prepare a sheet of alphabet, numbers, types of lines, and scales<br>2 To prepare a sheet of projections of the given points and lines.<br>3 To prepare a sheet of the projections of given plane surfaces.<br>4 To prepare a sheet of the projections of the given solids as per the description<br>5 To prepare a sheet of the projections of the section of solids as per the description<br>6 To prepare a sheet of development of the lateral surface<br>7 To prepare a sheet of isometric projections of a given solid.<br>8 To prepare a sheet of Orthographic projections of a given solid.   |          |
| <b>Textbooks</b><br>1. Engineering Drawing-Bhat, N.D.& M. Panchal, Charotar Publishing House, 2008                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |          |
| <b>Reference Books</b><br>1. Engineering Drawing and Computer Graphics- Shah, M.B. & B.C. Rana, Pearson Education, 2008<br>2. A Text Book of Engineering Drawing-Dhawan, R.K., S. Chand Publications, 2007<br>3. Text book on Engineering Drawing-Narayana, K.L. & P Kannaiah, Scitech Publishers, 2008                                                                                                                                                                                                                                                                                                                                 |          |

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|--------------------|----------------------------------------------------------|
| <b>BHS 101/151</b> | <b>UNDERSTANDING HUMAN VALUES: UNDERSTANDING HARMONY</b> |
|--------------------|----------------------------------------------------------|

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|----------------------------------|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course category</b>           | : | HSS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Pre-requisite Subject</b>     | : | NIL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Contact hours/week</b>        | : | Lecture : 3, Tutorial : 1 , Practical: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Number of Credits</b>         | : | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Course Assessment methods</b> | : | Continuous assessment through attendance, home assignments, quizzes, practical work, record, viva voce, one minor tests, One Major Theory Exam and major Practical Examination                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Course Objectives</b>         | : | The objectives of this course are to: -<br>1. Develop a holistic perspective in students based on self-exploration about themselves (human being), family, society and nature/existence.<br>2. Develop understanding (or developing clarity) in students about harmony in the human being, family, society and nature/existence.<br>3. Strengthen self-reflection in students.<br>4. Develop commitment and courage in students to act                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Course Outcomes</b>           | : | The students will be able to demonstrate the following knowledge, skills, and attitudes upon completion of the course: -<br>1. Ability to understand the interconnectedness of humanity and nature as well as the importance of values in interpersonal relationships.<br>2. Ability to recognize their role as global citizens and understand the importance of actively contributing to the betterment of society through responsible actions. 3. Ability to engage in critical reflection on their own values and beliefs, challenging assumptions and biases to foster personal growth and development. 4. Ability to appreciate and respect diversity thereby promoting communication and conflict resolution skills, promoting dialogue and understanding in resolving interpersonal and intergroup conflicts |

### Topics Covered

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| <b>UNIT-I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>9</b> |
| Introduction to Values: origin, definition, meaning, and types of values; Values in Education System; difference between Values, Morals, and Ethics; Self-Exploration-what is it? - Its content and process; 'Natural Acceptance' and 'Experiential Validation' as the process for self-exploration; Continuous Happiness and Prosperity- A look at basic human aspirations; Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority; Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario; Method to fulfil the above human aspirations: understanding and living in harmony at various levels.          |          |
| <b>UNIT-II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>9</b> |
| Understanding human being as a co-existence of the sentient 'I' and the material 'Body'; Understanding the needs of Self ('I') and 'Body' - happiness and physical facility; Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer); Understanding the characteristics and activities of 'I' and harmony in 'I'; Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail; Programs to ensure Sanyam and Health.                                                                                                                                                                                                                                 |          |
| <b>UNIT-III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>9</b> |
| Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship; Understanding the meaning of Trust; Difference between intention and competence; Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship; Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals; Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family. |          |
| <b>UNIT-IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>9</b> |
| Understanding the harmony in the Nature; Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature; Understanding Existence as Co-existence of mutually interacting units in all-pervasive space; Holistic perception of harmony at all levels of existence; Natural                                                                                                                                                                                                                                                                                                                                                                                                                           |          |

acceptance of human values; Definitiveness of Ethical Human Conduct; Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order; Competence in professional ethics.

### Textbooks & References

1. Andrews, C. (2006). Slow is beautiful. New Society Publishers.
2. Gandhi, M. K. (1909). Hind Swaraj or Indian Home Rule. Navjeevan Trust.
3. Gandhi, M. K. (2009). An Autobiography or The Story of My Experiments with Truth (Mahadev Desai, Trans.). Navjeevan Mudranalay. (Original work published 1925).
4. Gaur, R. R., Sangal, R., & Bagaria, G. P. (2010). A Foundation Course in Human Values and Professional Ethics. Excel Books.
5. Govindrajan, M., Senthilkumar, S., & Natarajan, M. S. (2013). Professional Ethics and Human Values. Prentice Hall India.
6. Kumarappa, J. C. (2017). Economy of Permanence. Sarva Seva Sangh Prakashan.
7. Naagarazan, R. S. (2022). A Textbook on Professional Ethics and Human Values. New Age International.
8. Rolland, R. (2010). Life of Vivekanad (4th Ed.). Advait Ashram.
9. Schumacher, E. F. (1973). Small is beautiful. A study of Economics as if people mattered. Blond & Briggs.
10. Suresh, J., & Raghavan, B. S. (2003). Human Values and Professional Ethics. S Chand.

## Semester II

| BSM 160                                                                                                                                                                                                                                                                                                                                                                                                              | ENGINEERING MATHEMATICS II |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Course category                                                                                                                                                                                                                                                                                                                                                                                                      | :                          | Basic Sciences & Maths (BSM)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Pre-requisite Subject                                                                                                                                                                                                                                                                                                                                                                                                | :                          | NIL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Contact hours/week                                                                                                                                                                                                                                                                                                                                                                                                   | :                          | Lecture : 3, Tutorial : 1 , Practical: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Number of Credits                                                                                                                                                                                                                                                                                                                                                                                                    | :                          | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Course Assessment methods                                                                                                                                                                                                                                                                                                                                                                                            | :                          | Continuous assessment through tutorials, attendance, home assignments, quizzes and one Minor tests and One Major Theory Examination                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Course Objectives                                                                                                                                                                                                                                                                                                                                                                                                    | :                          | The course is aimed to develop the basic mathematical skills of engineering students that are imperative for effective understanding of engineering subjects.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                      | :                          | <p>The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course</p> <ol style="list-style-type: none"> <li>1. To solve the ordinary differential equations.</li> <li>2. To solve the partial differential equations using Lagrange and charpit's method.</li> <li>3. To solve and understand the properties of Bessel's and Legendre's differential equation.</li> <li>4. Application of partial differential equation in real life problems</li> <li>5. To solve ODE and PDE with the help of Laplace transform</li> <li>6. To inculcate the habit of mathematical thinking and lifelong learning.</li> </ol> |
| <b>Topics Covered</b>                                                                                                                                                                                                                                                                                                                                                                                                |                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>UNIT-I</b>                                                                                                                                                                                                                                                                                                                                                                                                        |                            | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Ordinary Differential Equations I:</b> Linear differential equations with constant coefficients ( $n^{th}$ order), complementary function and particular integral. Simultaneous linear differential equations, solution of second order differential equations by changing dependent and independent variables, Method of variation of parameters, Applications of differential equations to engineering problems |                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>UNIT-II</b>                                                                                                                                                                                                                                                                                                                                                                                                       |                            | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Ordinary Differential Equations II:</b> Series solution of second order differential equations with variable coefficient (Frobenius method). Bessel and Legendre equations and their series solutions, Properties of Bessel function and Legendre polynomials.                                                                                                                                                    |                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>UNIT-III</b>                                                                                                                                                                                                                                                                                                                                                                                                      |                            | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

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| <b>Partial Differential equations:</b> Partial differential equations of the first order, Lagrange's solution, Charpit's general method of solution, Partial differential equations of the second order: Constant coefficient and reducible to constant coefficient, Classification of linear partial differential equations of second order.                                                                                                                                                                                       |          |
| <b>UNIT-IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>9</b> |
| <b>Laplace Transform:</b> Laplace Transform, Laplace transform of derivatives and integrals. Unit step function, Laplace transform of Periodic function. Inverse Laplace transform, Convolution theorem, Applications to solve simple linear and simultaneous differential equations and Partial Differential Equations.                                                                                                                                                                                                            |          |
| <b>Books &amp; References</b> <ol style="list-style-type: none"> <li>1. B.S. Grewal: Higher Engineering Mathematics; Khanna Publishers</li> <li>2. Erwin kreyszig: Advanced Engineering Mathematics, John Wiley &amp; Sons.</li> <li>3. R. K. Jain and Iyenger: Advanced Engineering Mathematics, Narosa Publications.</li> <li>4. B.V. Ramana: Higher Engineering Mathematics, Tata Mc. Graw Hill Education Pvt. Ltd.</li> <li>5. M.D. Raisinghania, Ordinary and Partial Differential Equations. S Chand Publications.</li> </ol> |          |

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| <b>BSM 140/BSM 190</b>                                                                                                                                                                                                                                                                                                                                                                | <b>ENVIRONMENTAL SCIENCE AND GREEN CHEMISTRY</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Course category:</b>                                                                                                                                                                                                                                                                                                                                                               | Basic Sciences & Maths (BSM)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Pre-requisite Subject:</b>                                                                                                                                                                                                                                                                                                                                                         | NIL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Contact hours/week</b>                                                                                                                                                                                                                                                                                                                                                             | Lecture : 3, Tutorial : 0 , Practical: 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Number of Credits:</b>                                                                                                                                                                                                                                                                                                                                                             | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Course Assessment methods:</b>                                                                                                                                                                                                                                                                                                                                                     | Continuous assessment through home assignments, quizzes, minor tests, practical work, viva-voce, practical exam and one minor test and one major theory Examination                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Course Objectives</b>                                                                                                                                                                                                                                                                                                                                                              | Understanding the principles and concepts of Chemistry viz. Chemical Bonding, acidity and basicity, Atmospheric Chemistry & Water Chemistry, Spectroscopic analytical methods and Green Chemistry and solving industrial problems using solid foundation in Chemistry.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Course Outcomes:</b>                                                                                                                                                                                                                                                                                                                                                               | <p>The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course</p> <ol style="list-style-type: none"> <li>1. To develop the concepts of basic chemistry.</li> <li>2. To make the students aware of global environmental issues e.g. global warming &amp; Greenhouse effect, Ozone depletion, pollution and its prevention and understand various aspects of atmospheric chemistry.</li> <li>3. To understand the analytical and conceptual skills required for environmental chemistry research.</li> <li>4. To understand water treatment for all types of uses and need to protect environment.</li> <li>5. To understand the specifications of pure water and its purification techniques.</li> <li>6. To develop the knowledge about Green Chemistry and Green Technology.</li> </ol> |
| <b>Topics Covered</b>                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Unit I</b>                                                                                                                                                                                                                                                                                                                                                                         | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Basic Chemical Concepts:</b> Periodic properties of elements, Ionization potential, electron affinity and electronegativity; mole concept, molarity and normality, Chemical Bonding – MO Theory, MO diagram of diatomic molecules, hydrogen bonding, electrophiles, nucleophiles, inductive effect and mesomeric effect. Reaction Mechanism. Acidity and basicity - Concept of pH. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Unit II</b>                                                                                                                                                                                                                                                                                                                                                                        | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Atmospheric chemistry &amp; Water Chemistry:</b> The atmosphere of Earth, layers of atmosphere and temperature inversion, Air pollution, Global warming and Greenhouse effect. Acid rain and Ozone layer                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

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| depletion. Chemical and photochemical Smog. Sources of water, conservation of water, impurities in water and their effects. WHO guideline and BIS guideline for drinking water. Hardness of water, Softening of water by Zeolite process, Lime Soda process, Ion exchange process and Reverse osmosis.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |          |
| <b>Unit III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>9</b> |
| <b>Spectroscopic analytical methods:</b> Absorbance, Transmittance and Beer-lamberts Law. Basic principles of UV-Visible spectroscopy, Fluorescence spectroscopy, Infrared spectroscopy, NMR Spectroscopy. Use of these instrumental techniques for monitoring of environmental pollution. Environmental problems posed by the use of non-biodegradable polymers widely used in day-to-day life. Incineration as the key method for disposal of polymeric waste. Bio-degradable polymers.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |          |
| <b>Unit IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>9</b> |
| <b>Green Chemistry:</b> Green Chemistry and Green Technology: New trends in Green chemistry; Green Chemistry Methodologies-Microwave heating, ultrasound technique. Green Chemical Synthesis Pathways; Green reagents, Green solvents.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |          |
| <b>Experiments:</b> <ol style="list-style-type: none"> <li>1. Determination of temporary and permanent hardness in water sample using EDTA as standard solution.</li> <li>2. Determination of alkalinity in the given water sample.</li> <li>3. Determination of chloride content in the given water sample by Mohr's method.</li> <li>4. Determination of percentage of available chlorine in bleaching powder sample.</li> <li>5. Determination of iron content in the given sample using <math>K_3[Fe(CN)_6]</math> as an external indicator.</li> <li>6. Determination of Electrical conductivity/TDS of a given water sample using conductivity meter.</li> <li>7. Determination of dissolved Carbon Dioxide of given water sample.</li> <li>8. Determination of the biochemical oxygen demand of sewage influent.</li> <li>9. To calculate the lambda max of the given compound by using UV-Visible spectrophotometer.</li> <li>10. Determination of nickel / cobalt / copper solutions by UV-visible spectrometry.</li> <li>11. Examples of Green Synthesis /Reactions.</li> <li>12. Determination of Turbidity of Water</li> <li>13. Iodoform test</li> <li>14. Synthesis of a polymer Bakelite or Polyacrylic acid.</li> </ol> |          |
| <b>Books &amp; References</b> <ol style="list-style-type: none"> <li>1. A Text Book of Environment and Ecology, Shashi Chawla, Tata McGraw Hill</li> <li>2. Environmental Studies, Raj Kumar Singh, Tata McGraw Hill</li> <li>3. Engineering Chemistry, Wiley India</li> <li>4. Engineering Chemistry, Tata McGraw Hill</li> <li>5. Organic Chemistry, Morrison &amp; Boyd, 6th edition, Pearson Education</li> <li>6. Fundamentals of Environmental Chemistry, Manahan, Stanley E., Boca Raton: CRC Press LLC.</li> <li>7. Environment and Ecology, R K Khandal, Wiley India</li> <li>8. An Introductory Text on Green Chemistry: For Undergraduate Students, Indu Tucker Sidhwani, Rakesh K. Sharma, Wiley</li> <li>9. A text book of Green Chemistry, Shankar Prasad Deo and Nayim Sepay, Techno World Publication.</li> <li>10. Introduction to Green Chemistry, John Andraos, Albert S. Matlack, CRC Press</li> </ol>                                                                                                                                                                                                                                                                                                              |          |

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| <b>BEE 107/ 157</b>          | <b>BASIC ELECTRICAL ENGINEERING</b> |                                       |
| <b>Course category</b>       | :                                   | Engineering Fundamentals (EF)         |
| <b>Pre-requisite Subject</b> | :                                   | NIL                                   |
| <b>Contact hours/week</b>    | :                                   | Lecture: 3, Tutorial: 0, Practical: 2 |
| <b>Number of Credits</b>     | :                                   | 4                                     |

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| <b>Course Assessment methods</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | : | Continuous assessment through attendance, home assignments, quizzes, practical work, record, viva voce, Minor tests and One Major Theory & Practical Examination.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Course Objectives</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | : | <ol style="list-style-type: none"> <li>1. To demonstrate and understand the basic knowledge of electrical quantities such as current, voltage, power, energy, and frequency to understand the impact of technology in a global and societal context.</li> <li>2. To demonstrate and understand the basic concepts of analysis of simple DC and AC circuits used in electrical engineering and apply the basic concepts in Electrical engineering for multi-disciplinary tasks.</li> </ol>                                                                                                                                                                                                                                                                                                                                                  |
| <b>Course Outcomes</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | : | <p>The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course:</p> <ol style="list-style-type: none"> <li>1. Understand the basic properties of electrical elements, and solve problem based on basic electrical circuits &amp; DC network theorems.</li> <li>2. Understand the fundamental behaviour of AC circuits and solve AC circuit problems.</li> <li>3. Apply the knowledge gained to explain the behaviour of the circuit at series &amp; parallel resonance of circuit &amp; the effect of resonance.</li> <li>4. Classify different electrical measuring equipment's and understanding their principles.</li> <li>5. Understand the basic concepts of magnetic circuits.</li> <li>6. Explain construction and working principle of transformer.</li> </ol> |
| <b>Topics Covered</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>UNIT I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>D C Circuit Analysis and Network Theorems:</b><br>Circuit Concepts: Concepts of network, Active and passive elements, Voltage and current sources, Concept of linearity and linear network, Unilateral and bilateral elements, R, L and C as linear elements, Source transformation, Kirchhoff's laws, Loop and nodal methods of analysis, Star-delta transformation, Network theorems: Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum Power Transfer theorem.                                                                                                                    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>UNIT II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Steady- State Analysis of Single-Phase AC Circuits:</b><br>AC fundamentals: Sinusoidal, square, and triangular waveforms – Average and effective values, Form and peak factors, Concept of phasor, phasor representation of sinusoidally varying voltage and current, Analysis of series, parallel and series-parallel RLC Circuits, Resonance in series and Parallel circuit Three Phase AC Circuits: Three phase system-its necessity and advantages, Star and delta connections, Balanced supply and balanced load, Line and phase voltage/current relations, three-phase power, and its measurement |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>UNIT III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Measuring Instruments &amp; Magnetic Circuit:</b><br>Types of instruments, Construction and working principles of PMMC and Moving Iron type voltmeters & ammeters, Use of shunts and multipliers. Magnetic circuit, concepts, analogy between electric & magnetic circuits, B-H curve, Hysteresis, and eddy current losses.                                                                                                                                                                                                                                                                             |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>UNIT IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Single-Phase Transformers:</b><br>Single Phase Transformer: Principle of operation, Construction, EMF equation, Power losses, Efficiency, O.C & S.C Test and Introduction to auto transformer.                                                                                                                                                                                                                                                                                                                                                                                                          |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>EXPERIMENTS</b> <ol style="list-style-type: none"> <li>1. Verification of Kirchhoff's Law.</li> <li>2. Verification of Norton's Theorem.</li> <li>3. Verification of Thevenin's Theorem.</li> <li>4. Verification of Superposition Theorem.</li> </ol>                                                                                                                                                                                                                                                                                                                                                  |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

5. Verification of Maximum Power Transfer Theorem.
  6. Verification of Series R-L-C circuit.
  7. Verification of Parallel R-L-C circuit.
  8. Measurement of Power and Power factor of three phase inductive load by two wattmeter method.
- To perform O.C. and S.C. test of a single-phase transformer.

**Textbooks:**

1. Fundamentals of Electric Circuits, C.K. Alexander and M.N.O. Sadiku; TATA McGraw-Hill.
2. Principles of Electrical Engineering, V. Del Toro; Prentice Hall International.

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| BCE 161                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |   | BUILDING PLANNING AND DRAWING                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |   |
| Course category                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | : | Professional Skill (PS)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |   |
| Pre-requisite Subject                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | : | NIL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |   |
| Contact hours/week                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | : | Lecture : 2, Tutorial : 0 , Practical: 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |   |
| Number of Credits                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | : | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |   |
| Course Assessment methods                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | : | Continuous assessment through attendance, home assignments, quizzes, practical work, record, viva voce One Minor tests, one Major theory exam and Practical Examination.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |   |
| Course Objectives                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | : | This course aims at the following educational objectives:<br><div><div>1.</div><div>To understand the fundamental principles and concepts of planning and architecture for buildings.</div></div> <div><div>2.</div><div>To study about different views of layout.</div></div> <div><div>3.</div><div>To learn the development controls covered by building bye laws and national building code for buildings.</div></div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |   |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | : | The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course<br><div><div>1.</div><div>Apply the concepts of building planning considering climatic parameters, building bye laws, classification of buildings and design buildings.</div></div> <div><div>2.</div><div>Draw site plan, plans, elevations and sectional views of residential, commercial and public buildings, showing maximum details of various building components using the available construction area effectively according to codal provisions and standard units Effectively analyse the geometrical shapes and to be able to draw.</div></div> <div><div>3.</div><div>Prepare building services drawings How to implement the different views for a solid placed in 3dspace.</div></div> <div><div>4.</div><div>Apply his knowledge to evaluate existing projects, suggest economical modifications for sustainable development and strengthen his professional skills through self-employability and lifelong learning.</div></div> <div><div>5.</div><div>Able to prepare a water supply line diagram.</div></div> <div><div>6.</div><div>Able to prepare a firefighting layout for buildings.</div></div> |   |
| Topics Covered                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |   |
| UNIT I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 6 |
| Introduction: Building Planning- Factors Shape size and topography of site, Climatic conditions of the site, Functional requirements of the building, Local Bye laws requirements of size of different components, setbacks, neighborhood, Owner :– Status-Choices-Preferences, Economy. Building Planning- Principles Aspects, Prospects, roominess, furniture requirements, groupings, circulation, privacy, elegance, lighting & ventilation, sanitation, flexibility, economy, practical considerations. |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |   |

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| <b>UNIT II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>6</b> |
| <b>Building Bye Laws</b> Building Bye Laws Means of access, internal and external open spaces, floor area ratio, height of building, safety precautions. Building Sanction procedures, key plan (layout plan), site plan, building plan, working plan, validity of sanction, completion certificate.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |          |
| <b>UNIT III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>6</b> |
| <b>Site Plan &amp; Planning of Buildings</b><br>Drawing of site plan showing setbacks, Floor Area Ratio, Height of Building, and Minimum Distance from Power line, as per National Building Code (NBC). Given the floor area or carpet areas of rooms, plan the building and draw a Single line diagram of building. a) Residential building b) School Buildings c) Hostel Buildings d) Primary Health Centre Draw the Plan, Elevation and Sectional views for the following types of buildings. a) Residential buildings. b) School Buildings c) Hostel Buildings d) Primary Health Centre e) Canteen Building f) Two storied residential building g) Small workshop Building.                                                                                                               |          |
| <b>UNIT IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>6</b> |
| <b>Building Basic Services</b><br>Preparation of water supply Layout for residential building.<br>Preparation of Electrical Layout for residential building.<br>Preparation of Sanitary Layout for residential building.<br>Preparation of Shallow Well Rain Water Harvesting Method for Building.<br>Preparation of Fire Fighting layout for buildings.                                                                                                                                                                                                                                                                                                                                                                                                                                      |          |
| <b>List of Experiments</b><br>1 To draw the different types of brick and brick masonry.<br>2 To draw the different types of doors and windows.<br>3 To draw a plan, elevation, and Section of the given building.<br>4 Plan the building and draw a single-line diagram of a residential building<br>5 Plan the building and draw a single-line diagram of a hostel building<br>6 Plan the building and draw a single-line diagram of a Primary Health Centre building<br>7 The Plan, Elevation and Sectional views for the Residential buildings<br>8 The Plan, Elevation and Sectional views for the Two storied residential building<br>9 The Plan, Elevation and Sectional views for the Small workshop Building.<br>10 The Plan, Elevation and Sectional views for the Hostel Buildings. |          |
| <b>Reference Books:</b><br>1. Civil Engg: Drawing Balagopal and RS Prabhu – Spades.<br>2. Time Savers standards for Building types – Joseph Deciera and John Callender Tata Mc Graw hill                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |          |

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| <b>BHS 102/152</b>               | <b>TECHNICAL WRITING AND PROFESSIONAL COMMUNICATION</b>                                                                                                                                                                                                                                                                                                                                  |
| <b>Course Category</b>           | HSS                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Prerequisite subject</b>      | None                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Number of Credits</b>         | 4                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Contact Hours/Week</b>        | Lectures: 3, Tutorial: 1, Practical: 0                                                                                                                                                                                                                                                                                                                                                   |
| <b>Course Assessment Methods</b> | Continuous assessment through One minor test, teacher's assessment (quiz, tutorial, assignment, attendance), and One Major Theory Examination.                                                                                                                                                                                                                                           |
| <b>Course Objectives</b>         | The objectives of this course are to: -<br>The course aims-<br>1. To sensitize the students to understand the role and importance of communication for personal and professional success.<br>2. To enable the learners to enhance their writing skills in techno-cultural and professional echo-system.<br>3. To equip learners to differentiate technical writing from general writing. |



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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <p>4.To equip them with technical writing skills.</p> <p>5.To enable learners to exhibit knowledge, skills, attitude and judgment in and around human communication that facilitate their ability to work collaboratively with others in an interpersonal environment.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Course Outcomes</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <p>The students will be able to demonstrate the following knowledge, skills, and attitudes upon completion of the course:</p> <p>-</p> <ol style="list-style-type: none"> <li>1.Overcome the problems she/he shall faces in oral and written communication.</li> <li>2.Acquire knowledge of and methods for using technical communication, such as reports, proposals, technical letters, etc.</li> <li>3.Use and Practice compositions correctly.</li> <li>4.Give presentations in different sessions and make self-appraisal.</li> <li>5.Learn and understand the various facets of Communication Skills, such as (LSRW) Listening, Speaking, Reading, and writing, and</li> <li>6. Identify, formulate, and solve real-life problems with a positive attitude; also inculcate, the habit of learning and developing communication and soft skills.</li> </ol> |
| <b>UNIT I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>6</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <p><b>Language and Communication</b></p> <p>Language Vs communication: Communication as coding and decoding – signs, symbols &amp; pictograph – verbal and non-verbal symbols – Language &amp; communication; Types of Communication- functional, situational, verbal, and non-verbal, interpersonal, group, interactive, public, Mass Communication. Thinking and Articulation, critical, creative aspects of articulation.</p> <p><b>Skills of Language Acquisition:</b> Natural Language Acquisition Skills: Listening, Speaking, Reading &amp; Writing {LSRW}; Language Acquisition Through Training: Listening, Speaking, Reading, Writing, Grammar &amp; Vocabulary {LSRWGV}</p> <p><b>Phrase, Clause &amp; Sentence in Professional Drafting-</b>Simplicity, Clarity and Conciseness of a Presentation, Differentiating between Professional and Creative Writing, Blending of Artistic/Professional Writing, Avoiding gender, racial, and other forms of bias in Professional Writing. Pre-writing, Drafting, and Re-writing.</p>                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>UNIT II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>6</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <p><b>Towards Technical Writing:</b></p> <p><b>Technical Paper Writing:</b> Professional Paper Elements-Front Matter of a Paper, Main Text of a Paper, End Matter of a Paper: Organizing References and Bibliography, Order of a thesis and Paper Elements, Concluding Remarks. Methods of Research Paper Writing: Identification of Author and His Writing-Author's name and Affiliation, Joint Authorship of a Paper, Identification of Writing- Title, Keywords, Synopsis, Preface and Abstract. Drafting Research Article &amp; Methodology.</p> <p><b>Thesis/Dissertation Writing:</b> Thesis Elements-Front Matter of a Thesis, Main Text of a Thesis, End Matter of a Thesis, Specimen—Thesis and Research Paper, Chapters and Sections-Introductory Chapters and Sections, Statement of the Problems, Plan and Scope, Core Chapters and Sections- Theoretical Analysis and Synthesis, Basic Assumption and Hypothesis.</p> <p><b>Professional Presentation &amp; Seminar Delivery Tools:</b> Designing the Presentation; Establishing the Objectives. Making Professional PowerPoint Presentations, Signaling Structure of Presentation through Sentences and Crisp Phrases, Preparing Notes for Professional/Technical Presentation, Text Animation, White Board, Flip Charts, Diagrams, Preparing Cards. Seminar Presentations: Purpose modes and methods. Nascent Emerging Platforms for On-line Presentations viz. Zoom, Webex, Team &amp; Meet etc.</p> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

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| <b>UNIT III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>6</b> |
| <p><b>Professional Drafting:</b> Letters vs. e-mails, Formal and Informal emails, Parts of e-mails, Types of e-mails, Managing tone of E-mails and business Letters, Examples of Letters and E-mail, Professional Correspondence through E-mail, Job Applications and cover Letters. Introduction to DOs (Demi- Official Letters)</p> <p><b>Career &amp; Correspondence:</b> Developing a Professional C.V, Bio Data &amp; Resume. Report Writing, Kinds of Reports, Length of Report, Parts of a Report, Terms of Reference, Collection of Facts, Outlines of Report, Examples of Report, Technical Proposal, Elements of Proposal, Examples of Proposal, drafting of proposal.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |          |
| <b>UNIT IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>6</b> |
| <p><b>Conducting Professional Meeting:</b> Pre-meeting Preparation, During Meeting: Action Taken Report (ATR) &amp; New Agenda Points, Post Meeting Follow ups. Notice, Circular, Agenda &amp; Meeting Minutes.</p> <p><b>Introduction to Generation-Z,</b> Cyber Identity &amp; Professional Netiquettes for Netizens: Drafting E-mails, Blogs on social media, Videoconferencing. Managing Profiles on social media. What to Write and Share on social media. Telephone Etiquettes &amp; Phubbing.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |          |
| <b>List of Practical</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |          |
| <ol style="list-style-type: none"> <li>1. Introduction to Vowel and Consonant Sounds</li> <li>2. Monophthongs and Diphthongs</li> <li>3. Syllable, Word Stress &amp; Intonation</li> <li>4. Harnessing Non-verbal Communication Skills in Cross-Cultural Environment for the establishment of an ideal Ecosystem to ensure Professional Success</li> <li>5. Developing Speech, and Proofreading the Same</li> <li>6. Argumentative Skills &amp; Group Dynamics</li> <li>7. Preparing CV, Biodata &amp; Resume</li> <li>8. Types of Interview and Interview Skills</li> <li>9. GD, PI &amp; Telephonic Interview</li> <li>10. Presentation Skills, Extempore, Debate and Video Conferencing</li> <li>11. Netiquettes while Writing Blogs on social media.</li> <li>12. Ethical Usages of Generative AI</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |          |
| <p><b>Text / Reference Books</b></p> <ol style="list-style-type: none"> <li>1. Acharya Anita. (2012) Interview Skills- Tips &amp; Techniques. Yking Books, Jaipur.</li> <li>2. Basu, B. N., (2008) Technical Writing. PHI Learning Pvt. Ltd., New Delhi.</li> <li>3. Chauhan, N. K &amp; Singh, S. N. (2013) Formal Letters, Pankaj Publication International, New Delhi.</li> <li>4. Chhabra T.N. (2018) Business Communication. Sun India Publication New Delhi.</li> <li>5. Dubey Arjun et.al. (2016) Communication for Professionals. Alfa Publications, Delhi.</li> <li>6. Gibaldi, Joseph (2021). The MLA Handbook for Writers of Research Papers. Ed. IXth, Modern Language Association of America, NY, US.</li> <li>7. Gurumani, N. (2010) Scientific Thesis Writing and Paper Presentation, MJP Publishers, Chennai.</li> <li>8. Hamilton Richard. (2009) Managing Writers. Penguin, India.</li> <li>9. Mc Graw S. J. (2008) Basic Managerial Skills for All. Ed. 08th, Prentice Hall of India, New Delhi.</li> <li>10. Murphy &amp; Hildebrandt. (2008) Effective Business Communication. Tata McGraw Hill New Delhi.</li> <li>11. Pandey, S.P., Singh, S. N. &amp; Kumar, Raman, (2023) Exploring Digital Humanities: Challenges &amp; Opportunities, MacBrain Publishing House, New Delhi.</li> </ol> |          |

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| <b>BCE 162</b>               | <b>DESIGN THINKING IN CIVIL ENGINEERING</b> |                                          |
| <b>Course category</b>       | :                                           | VAC/AC                                   |
| <b>Pre-requisite Subject</b> | :                                           | NIL                                      |
| <b>Contact hours/week</b>    | :                                           | Lecture : 0, Tutorial : 0 , Practical: 2 |
| <b>Number of Credits</b>     | :                                           | 0                                        |

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| <b>Course Assessment methods</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | : | Continuous assessment through attendance, home assignments, quizzes, practical work, record, viva voce and Practical Examination, one minor test and one major examination                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Course Objectives</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | : | The objective of this Course is to provide the new ways of creative thinking and Learn the innovation cycle of Design Thinking process for developing innovative products which are useful for a student in preparing for an engineering career.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Course Outcomes</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | : | <p>The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course.</p> <ol style="list-style-type: none"> <li>1. Compare and classify the various learning styles and memory techniques and Apply them in their engineering education.</li> <li>2. Analyze emotional experience and Inspect emotional expressions to better understand users while designing innovative products</li> <li>3. Develop new ways of creative thinking and Learn the innovation cycle of Design Thinking process for developing innovative products</li> <li>4. Identification of real-time civil engineering problems and their innovative solutions.</li> <li>5. Perceive individual differences and its impact on everyday civil engineering project decisions and further create a better project execution.</li> </ol> |
| <b>Topics Covered</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>UNIT I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>An Insight to Learning:</b> Understanding the Learning Process, Kolb's Learning Styles, Assessing and Interpreting<br><b>Remembering Memory:</b> Understanding the Memory process, Problems in retention, Memory enhancement techniques<br><b>Emotions: Experience &amp; Expression:</b> Understanding Emotions: Experience & Expression, Assessing Empathy, Application with Peers                                                                                                                                                                                              |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>UNIT II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Basics of Design Thinking:</b> Definition of Design Thinking, Need for Design Thinking, Objective of Design Thinking, Concepts & Brainstorming, Stages of Design Thinking Process (explain with examples) - Empathize, Define, Ideate, Prototype, Test<br><b>Being Ingenious &amp; Fixing Problem:</b> Understanding Creative thinking process, Understanding Problem Solving, Testing Creative Problem Solving                                                                                                                                                                  |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>UNIT III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Infrastructure Design Concepts:</b> Introduction to infrastructure design approaches for different projects, Various IRC and IS codes guidelines for design of various infrastructure components. General Principles of Design, Drawing, Importance of Safety, Case study of best infrastructures projects in current scenario, Introduction to ethical construction practices, application of project management tools, Standards and Quality practices in production, construction, maintenance, and services.                                                                 |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>UNIT IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Prototyping &amp; Testing:</b> Concept of Prototype, Prototyping – Virtual and Physical. Rapid Prototype Development process, Testing Methodology, Testing and Sampling process in civil engineering.<br><b>Energy and Environment:</b> Conservation, environmental pollution, and degradation, Climate change, Environmental impact assessment.<br><b>Information and Communication Technologies (ICT)</b> based tools and their applications in Engineering include networking, e-governance, and technology-based education, Ethics and values in the Engineering profession. |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

**Textbooks**

1. E Balaguruswamy (2022), Developing Thinking Skills (The way to Success), Khanna Book Publishing Company.
2. Change by Design, Tim Brown, Harper Bollins (2009)
3. Design Thinking in the Classroom by David Lee, Ulysses Press

**Reference Books**

1. Design the Future, Shrrutin N Shetty, Norton Press
2. Universal principles of design- William lidwell, kritina holden, Jill butter.
3. The era of open innovation – Chesbrough.H

### Semester III

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| <b>BCE 210</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>CIVIL ENGINEERING MATERIALS, EVALUATION AND TESTING</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Course category</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | :                                                          | Engineering Fundamental (EF)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Pre-requisite Subject</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | :                                                          | NIL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Contact hours/week</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | :                                                          | Lecture : 3, Tutorial : 0 , Practical: 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Number of Credits</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | :                                                          | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Course Assessment methods</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | :                                                          | Continuous assessment through tutorials, attendance, home assignments, quizzes and One Minor tests and One Major Theory & Practical Examination                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Course Objectives</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | :                                                          | The objective of this Course is to deal with an experimental determination and evaluation of mechanical characteristics and advanced behavior of construction materials.                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Course Outcomes</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | :                                                          | <p>The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course</p> <ol style="list-style-type: none"> <li>1. Make measurements of behavior of various materials used in Civil Engineering.</li> <li>2. Provide physical observations to complement concepts learnt</li> <li>3. Introduce experimental procedures and common measurement instruments, equipment, devices.</li> <li>4. Exposure to a variety of established material testing procedures and techniques</li> <li>5. Different methods of evaluation and inferences drawn from observations</li> </ol> |
| <b>Topics Covered</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>UNIT I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                            | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <p><b>Building Stones and Stone Aggregates:</b> Introduction Classification of Rocks Geological Classification Physical and Chemical Classification Common Building Stones and Their Uses, Quarrying of St Quarrying Methods, Criteria for Selection of Stones, Characteristics to be Considered in Selection of Stones. Deterioration and Preservation of Stones, Artificial Stones, Stone Veneering; Aggregates: Requirement of stone for aggregates, Physical and Chemical characteristics of aggregates, Gradation and Gradation Zones of aggregates</p> <p><b>Clay Bricks:</b> Genera, Brick clay, Preparation of Bricks, Types of Clay Bricks. Chemical Changes in Burning of Bricks, Dimensions of Bricks, Bricks for Special Use Conventional and Specially Shaped Bricks, light Weight Clay Bricks, Brick Substitute, Test on Bricks</p> <p><b>Cement and Concrete Blocks:</b> Introduction, Manufacturing of Concrete Blocks, Dimensions and Tolerance, Classification of Concrete Blocks, Storage of Blocks, Autoclaved Aerated Concrete Blocks, Use of Block Masonry in Buildings, Testing of Blocks (IS 2185)</p> |                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>UNIT II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                            | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <p><b>Cement:</b> Raw materials used, Process of Manufacturing, Chemical composition, compounds formed and their effect on strength, Types of cement Grades of Cement produced in India, Sampling and Testing of cement properties, Uses of cement, Storage of Cement, Adulteration of Cement</p> <p><b>Lime:</b> Cementing Action of Lime, Classification of Lime, Slaking of Quicklime to Prepare Slaked Lime, Tank Slaking of Quicklime to Prepare Lime Putty Storing Lime, Precautions in Handling Lime, Tests for Lime, Field and Laboratory Tests for Building Lime</p> <p><b>Mortars:</b> Classification, Uses, Characteristics of good mortar, Ingredients. Cement mortar, Lime mortar, Lime cement mortar, special mortars; Pozzolanic Materials, Advantages of Addition of Pozzolanas, Storing of Pozzolanas Required Chemical and Physical Characteristics of Fly ash</p>                                                                                                                                                                                                                                           |                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>UNIT III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                            | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <p><b>Wood and Wood Products:</b> Classification of Timber, Structure, Characteristics of good timber, Seasoning of timber, Defects in Timber, Diseases of timber, Decay of Timber, Preservation of Timber Testing of Timber,</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

Industrial Timber Products such Veneers , Plywood, Fiber Boards, Particle Boards, Chip Boards, Paints, Enamels and Varnishes: Composition of oil paint, characteristic of an ideal paint, preparation of paint, covering power of paints, Painting: Plastered surfaces, painting wood surfaces, painting metal Surfaces. Defects, Effect of weather, enamels, distemper, Varnish, Miscellaneous Materials: Gypsum: Classification, Plaster of Paris, Gypsum wall Plasters, Gypsum Plaster Boards, Adhesives, Heat and sound insulating materials, Geo synthetics

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| <b>UNIT III</b> | <b>9</b> |
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**Concrete:** Production, Properties of Fresh, Gradation of Concrete, Transportation and placement of concrete, Concrete Additives Admixtures Different Types of Concrete Special Structural Concretes Cast Iron and Steel Introduction, Manufacture, Iron-Carbon Alloys, Manufacture of Thermo-mechanically Treated (TMT) Bars, Equilibrium Diagram (Iron-Carbon Phase Diagram), Other Factors in Making Iron Products, Effect of Rate of Cooling Mechanical Working (Treatment) of Steel, Hot Working of Steel, Cold Working of Steel, Heat Treatment of Steel, Mild Steel and Other Steels , Wrought Iron, Cast Iron, Malleable Cast Iron, Spheroidal Graphite Iron (Ductile Iron), Corrosion Resistance of Cast Iron, Rolled Steel Structural Sections and other market forms of steel

**Aluminum and its alloy:** Manufacture, Description of the Process, Processing of Aluminium Metal, Conversion into Different Products, Improving Surface Appearance, Improving Appearance by Anodizing of Aluminium, Improving Appearance by Powder Coating of Aluminium, Comparison of Colouring Processes, Characteristics and Advantages of Aluminium as a Construction Material, Available Forms of Aluminium and Their Uses, Aluminium Alloys Important Alloys for Industrial Use, Uses of Aluminium in Building Construction

**Other Metals and Their Alloys:** Copper and Its Alloys, Alloys of Copper, Zinc and Its Alloys, Use of Zinc for Manufacturing of GI Sheets, Other Metals

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| <b>UNIT IV</b> | <b>9</b> |
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**Plastic and Plastic Pipes**

Short History of Plastics, Polymerization of Plastics, Classification of Plastics Classification According to Mechanical Property, Properties of Plastics, Fabrication of Plastic Articles, Moulding Compounds, Fabrication Methods Used for Making Plastic Articles Some Plastics in Common Use, Vinyls—Polyvinyl Chloride (PVC), Acrylics—Polymethyl Methacrylate (PMMA). Perspex, Polycarbonate (PC), Polyethylene (PE), Nylo, Terylene (Polyester) , Amino Plastics—Formaldehydes, Casin, Epoxy Resins, Reinforced Plastics, Glass Fibre Reinforced Polyesters (GFRP), Carbon Fibre Reinforced Plastic (CFRP), Thermocol, PVC Floor Sheets/Tiles, Laminated Plastics—Formica , Use of Plastics for Doors and Windows, Use of Plastics for Roofing, Polyethylene (Polythene) Water Tanks , Compounding Plastics with Rubber

**Rubber:** Natural Rubber, Synthetic (Polymer) Rubber, Vulcanization of Rubber, Uses of Rubber in Building Construction, Rubber in Cement Mortar and Concrete, Rubber Floors,

**Materials for Flooring:** Ceramic Tiles , Terrazo (Mosaic) Tiles, Materials for Terrazo Tiles, Manufacture of Terrazo Tiles, Test Requirement of Precast Cement-Concrete Terrazo Tiles, Terrazo Laid In Situ, Stone Flooring, Marble Stone Flooring, Resilient Floor Materials , Rubber Flooring (IS 809-1970), Linoleum Flooring (IS 653-1962), PVC Sheet and Tile Flooring (IS 3492-1966), Selection of Type of Floor Geo-synthetic and WPC, ACP and other New Materials

**Pipes Used in Building Construction:** Cast Iron Pipes, Plastic Pipes, Galvanized Steel (GI) Pipes, Stoneware Pipes Asbestos Cement (AC) Pipes, Concrete Pipes

**Practical:**

Bricks: Water absorption, Dimension Tolerances, Compressive strength, Efflorescence

Cement: Normal Consistency of cement, Initial & final setting time of cement, Compressive strength of cement, Fineness of cement, Soundness of cement, Tensile strength

Coarse Aggregate: water absorption of aggregate, Sieve Analysis of Aggregate, Grading of aggregates. Fine Aggregate: Sieve analysis of sand, Silt content of sand, Bulking of sand

Cement concrete: Workability tests, compressive strength, Tensile strength

**Textbooks**

1. Building Materials and Construction – Arora & Bindra, Dhanpat Roy Publications.
2. Building Materials and Construction by G C Sahu, Joygopal Jena McGraw hill Pvt Ltd 2015.
3. Building Construction by B. C. Punmia, Ashok Kumar Jain and Arun Kumar Jain - Laxmi

Publications (P) Ltd., New Delhi.

#### Reference books

1. Building Materials by Duggal, New Age International.
2. Building Materials by P. C. Varghese, PHI.
3. Building Construction by PC Varghese PHI.
4. Construction Technology – Vol – I & II by R. Chubby, Longman UK.
5. Alternate Building Materials and Technology, Jagadish, Venkatarama Reddy and others; New Age Publications.

| BCE 211                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |   | SOIL MECHANICS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Course category                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | : | Engineering Fundamental (EF)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Pre-requisite Subject                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | : | NIL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Contact hours/week                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | : | Lecture: 3, Tutorial : 0 , Practical: 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Number of Credits                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | : | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Course Assessment methods                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | : | Continuous assessment through attendance, home assignments, quizzes, practical work, record, viva voce and One Minor test and One Major Theory & Practical Examination                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Course Objectives                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | : | <p>The objectives of the course are as follows:</p> <ol style="list-style-type: none"> <li>1. To develop an appreciation of soil as a vital construction material, so that it may subsequently be used in the design and construction of foundation for civil engineering structures.</li> <li>2. To develop an understanding of the relationships between physical characteristics and mechanical properties of soils.</li> <li>3. To inculcate the basic knowledge of classification and engineering properties of soil and its suitability as a foundation/subgrade material.</li> <li>4. To understand the experimental methods for physical and mechanical soil properties</li> </ol>                                                                        |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | : | <p>After completion of this course the students to demonstrate following knowledge, skills and attitudes.</p> <ol style="list-style-type: none"> <li>1. Fundamental differences in engineering behavior between cohesive and cohesionless soils.</li> <li>2. Compute the groundwater seepage and distribution of ground water pressure.</li> <li>3. Compute the applied stress beneath the ground surface.</li> <li>4. Demonstrate the fundamental difference in the strength and deformation characteristics of cohesive and cohesionless soils.</li> <li>5. Analyze field and laboratory data to determine the strength and deformation properties of cohesive and cohesionless soils.</li> <li>6. Compute settlements due to consolidation of soil.</li> </ol> |
| <b>Topics Covered</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>UNIT I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Geological Characteristics of Soils: Origin of soils and rocks; composition of soils: soil formation, types, clay minerals, and soil fabric; soil structure; coarse-grained and fine-grained soil for engineering use. Physical Soil Parameters: Basic three phase relationships; index properties of soil; dry unit weight-water content relationship; Atterberg's limits; soil classification schemes.                                                                                                                                                |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>UNIT II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Soil Compaction: Laboratory compaction; Standard and Modified Proctor compaction tests; zero air void curve; factors affecting soil compaction; field compaction; compaction quality control: Proctor Needle Test, Purpose and Phases of Soil Investigation.<br>One-dimensional flow of water through soils: concept of permeability, Darcy's law, flow parallel/normal to soil layers; determination of hydraulic conductivity; equivalent hydraulic conductivity; quicksand condition; seepage and flow nets, flow through dams and design of filters |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>UNIT III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

Stresses, Strains, and Elastic Deformation of Soil: Stresses in soil from surface loads; Boussinesq's theory and Westergaard theory under point loading, circular area loading; Newmark's Influence chart. Consolidation of Soils: Compressibility and consolidation characteristics Terzaghi's One-dimensional consolidation theory; settlement of compressible soil layers; calculation of primary consolidation settlement. determination of coefficient of consolidation and secondary consolidation (creep), Over Consolidation Ratio and Effective stress principles

#### UNIT IV

Shear Strength of Soils: Mohr circle of stress; Mohr-Coulomb failure criterion; estimation of shear strength parameters for soil; laboratory tests to determine the shear strength parameters of soils: direct shear test, triaxial tests (UU, CU, and CD), and vane shear test; Concept of pore water pressure, Skempton's pore pressure parameters. Stability of Slopes: Infinite and finite slope; two-dimensional slope stability analysis; methods of slices: Bishop's method, Taylor's method, and Bishop-Morgenstern method; concept of factor of safety.

#### Geotechnical Engineering Lab Experiments

1. Classification of soil using Particle Size analysis.
2. Determination of specific gravity of soil grains.
3. Determination of liquid and plastic limits, and shrinkage limit.
4. Proctor compaction test.
5. Determination of relative density.
6. In-situ density – core cutter method and sand replacement method.
7. Permeability test – falling head and constant head methods.
8. Determination of coefficient of consolidation using oedometer test.
9. Determination of shear strength parameters using direct shear test.
10. Determination of shear strength parameters using triaxial test.

#### Textbooks

- Alam Singh – Modern Geotechnical Engineering, Asia Publishing House, New Delhi.
- Gopal Ranjan and A.S.R. Rao – Basic and Applied Soil Mechanics, New Age International (P) Ltd.
- B.C. Punamia – Soil Mechanics and Foundations, Laxmi Publications (P) Ltd.

#### Reference Books

- Brij Mohan Das – Geotechnical Engineering, CENGAGE Learning.
- I.H. Khan – Textbook of Geotechnical Engineering, Prentice-Hall of India Ltd., New Delhi.
- C. Venkataramaiah – Geotechnical Engineering, New Age International (P) Ltd., New Delhi.
- Shashi Gulati & Manoj Datta – Geotechnical Engineering, Tata McGraw Hill, New Delhi.
- J.E. Bowles – Foundation Analysis & Design, McGraw Hill, New Delhi.
- K.R. Arora – Soil Mechanics & Foundation Engineering, Standard Publishers & Distributors, Delhi.
- V.N.S. Murthy – Soil Mechanics and Foundation Engineering, CBS Publication.
- Muni Budhu- Soil Mechanics and Foundations, Wiley India Pvt. Ltd.

| BCE 212                   |   | STRUCTURAL MECHANICS                                                                                                                                                 |
|---------------------------|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Course category           | : | Professional Core (PC)                                                                                                                                               |
| Pre-requisite Subject     | : | Mechanics of structures                                                                                                                                              |
| Contact hours/week        | : | Lecture : 3, Tutorial : 0 , Practical: 2                                                                                                                             |
| Number of Credits         | : | 4                                                                                                                                                                    |
| Course Assessment methods | : | Continuous assessment through tutorials, assignments, quizzes and one Minor tests and One Major Theory & Practical Examination.                                      |
| Course Objectives         | : | The objective of this course is:<br>1. To learn the fundamental concepts of stress, strain, and deformation of solids with applications to bars, beams, and columns. |



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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |   | <p>2. Detailed study of engineering properties of materials is also introduced.</p> <p>3. Fundamentals of applying equilibrium, compatibility, theories of failure and energy methods and force deformation relationships to structural elements are also emphasized.</p> <p>4. To introduce the concepts for calculating the deflection of beams with various loading conditions. And builds the fundamental concepts of unsymmetrical bending and curved beams.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Course Outcomes</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | : | <p>The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course</p> <ol style="list-style-type: none"> <li>1. Identify the basic concepts of structural mechanics including static equilibrium, geometry of deformation, and material constitutive behavior.</li> <li>2. Executing the fundamental concepts of stress, strain, and elastic behaviour of materials to analyze structural members subjected to tension, compression, torsion.</li> <li>3. Analyze the bending and shear stress on different types of sections.</li> <li>4. Formulate an appropriate theoretical basis for the analysis of combined axial and bending stresses.</li> <li>5. Understand the behavior of columns and struts under axial loading.</li> <li>6. Demonstrate the use of critical thinking and problem-solving techniques as applied to structural systems.</li> </ol> |
| <b>Topics Covered</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>UNIT I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |   | 9                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Simple Stress and Strain, Poisson's ratio, Different Moduli of elasticity and their relations. Compound stresses and strains: Introduction: normal stress and strain, shear stress and strain, stresses on inclined plane, strain energy, impact loads and stresses, state of plane stress, principal stress and strain, maximum shear stress, Mohr's stress circle three-dimensional state of stress & strain, equilibrium equation, generalized Hook's law, theories of failure, composite bars, Temperature stresses |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>UNIT II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |   | 9                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Bending Moment, Shear Force Diagram for beams and determinate structural members. Bending Stresses: Derivation of formula, bending stress distribution across various beam sections like rectangular, circular, triangular, I, T angle sections, composite beam Shear Stresses: Derivation of formula, Shear stress distribution across various beam sections like rectangular, circular, triangular, I, T angle sections, composite beam.                                                                              |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>UNIT-III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |   | 9                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Deflection of beam: Equation of elastic curve, cantilever and simply supported beam, Macaulay's method, Moment Area method, Unit Load Method. Strain Energy Methods and Strain Energy theorems. Torsion- Derivation of torsion equation and its assumptions. Applications of the equation of the hollow and solid circular shafts, torsional rigidity, Combined torsion and bending of circular shafts, principal stress and maximum shear stresses under combined loading of bending and torsion.                      |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>UNIT-IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |   | 9                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Combined bending and direct stress, middle third and quarter fourth rules. Columns and struts: Buckling and Stability, slenderness ratio, Euler's Crippling Load, Buckling Loads for columns with various end conditions. Empirical formulae for evaluation of Buckling Load. Curved Beams: Bending of beams with initial curvature. Unsymmetrical Bending. Shear Centre                                                                                                                                                |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>List of Experiments:</b> Following experiments to be carried out: <ol style="list-style-type: none"> <li>1. Flexural rigidity of beams</li> <li>2. Unsymmetrical bending</li> <li>3. Buckling load of struts</li> <li>4. Deflection of curved members</li> <li>5. Verification of Maxwell Betti's Reciprocal theorems</li> </ol>                                                                                                                                                                                     |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Textbooks</b> <ol style="list-style-type: none"> <li>1. Hibbeler, R. C. Mechanics of Materials. 6th ed. East Rutherford, NJ: Pearson Prentice Hall, 2004</li> <li>2. Timoshenko, S. and Young, D. H., "Elements of Strength of Materials", DVNC, New York, USA.</li> <li>3. Jain, O.P. and Jain, B.K., "Theory &amp; Analysis of Structures. Vol. I &amp; II Nem Chand.</li> <li>4. James M. Gere, Barry J. Goodno, "Mechanics of Materials" Cengage Learning</li> </ol>                                             |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

**Reference Books**

1. Coates, Coates, R.C., Coutie, M.G. & Kong, F.K., "Structural Analysis", English Language Book Society & Nelson, 1980.
2. Ghali, A. & Neville, M., "Structural Analysis", Chapman & Hall Publications, 1974. 25
3. Jain, A.K. "Advanced Structural Analysis", Nem Chand & Bros, Roorkee, India, 1996.
4. Kazmi, S. M. A., "Solid Mechanics" TMH, Delhi, India.

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| BCE 213                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |   | BASIC SURVEYING                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |   |
| Course category                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | : | Professional Core (PC)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |   |
| Pre-requisite Subject                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | : | NIL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |   |
| Contact hours/week                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | : | Lecture:3 ; Tutorial: 0 ; Practical:2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |   |
| Number of Credits                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | : | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |   |
| Course Assessment methods                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | : | Continuous assessment through tutorials, attendance home assignments, quizzes, practical work, record, viva voce and one Minor tests and One Major Theory & Practical Examination                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |   |
| Course Objectives                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | : | The objective of this course is to develop an understanding of the basic principles of surveying including the traditional measurements and representations and thereby preparation of maps and plans showing the relative position of existing features by which areas, volumes and other related quantities can be determined.                                                                                                                                                                                                                                                                                                                                                                                                                                                               |   |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | : | The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course<br>1. To understand the importance of surveying in the field of civil engineering<br>2. To be able to use conventional surveying tools such as chain/tape, compass, plane table, in the field of civil engineering applications<br>3. To know the basics of levelling and theodolite/ Tacheometer in elevation and angular measurements<br>4. To understand traversing and numerical aspects of traversing<br>5. To take accurate measurements, and carry out field booking, plotting and adjustment of errors in a traverse<br>6. Students learn to work with others, respect the contributions of others, resolve difficulties, and understand responsibility |   |
| Topics Covered                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |   |
| UNIT-I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 9 |
| Introduction and Principles of surveying, Plane and Geodetic Surveying, Control Points, Classification of surveys, Horizontal and Vertical Control Measurement by chain and tape. Sources of errors and precautions, Corrections to tape measurements, Compass surveying, Instruments, Surveyors and Prismatic compass, Bearing of survey lines, systems and conversions, Local attraction, Traversing, Latitude and departure, Traverse adjustment of closing errors, Computation of coordinates. Maps, their scales, referencing system and uses, plotting accuracy; Map coordinate system; projections and their types.           |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |   |
| UNIT-II                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 9 |
| Different methods of determining elevation; Spirit levelling: Definition of terms, Principle, Construction, Temporary adjustments of levels. Automatic levels, Digital Level, Levelling staves, Methods of spirit levelling, Booking and reduction of fields notes, Curvature and refraction, Reciprocal leveling, Trigonometric leveling - simple and reciprocal observations, Sources of errors and precision of leveling procedures.<br>Contouring: Definition and characteristics of contours, contour interval, horizontal equivalent, Direct and Indirect methods of contouring, Use of contour maps, Digital Elevation Model. |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |   |
| UNIT III                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 9 |

Theodolite surveying, Vernier theodolite, Temporary adjustments, Measurement of horizontal and vertical angles, Methods of repetition and reiteration, errors in theodolite surveying, elimination of errors, working of Electronic Theodolites Tacheometric surveying, Principles, Methods – Stadia system – Fixed hair methods, Methods with staff held vertical and normal, Analytic lens, Subtense bar, Tangential method.

#### UNIT IV

9

Plane Table surveying, instruments and accessories, advantages and disadvantages of plane table surveying, methods – radiation, intersection, traversing, resection – Two- and three-point problems, errors in plane table surveying. Map preparation with plane table. Area and volume computation: area from latitude and departure, Simpson's rule and Trapezoidal rule. Volume of level and two level sections, Trapezoidal and prismoidal formulae with corrections

#### Basic Survey Lab/ Field Work

##### Minimum Eight experiments are to be conducted from the following:

1. To study instruments used in chain surveying and to measure distance between two points by ranging.
2. To determine the bearing of sides of a given traverse using Prismatic Compass, and plotting of the traverse.
3. To find out the reduced levels of given points using level. (Reduction by Height of Collimation method and Rise and Fall Method).
4. To determine and draw the longitudinal and cross-section profiles along a given route.
5. Practice for temporary adjustments of a Vernier Theodolite and taking horizontal (by Repetition and Reiteration methods) and Vertical angular measurements.
6. Measurement of horizontal angles by Repetition method.

#### Textbooks

1. K.R. Arora, "Surveying", Vol. I & II Standard Book House, Delhi,
2. B.C Punmia, "Surveying", Vol. I, II & III Laxmi Publication
3. S.K. Duggal., Surveying Vol. I & II Tata McGraw Hill
4. A.M. Chandra., "Plane Surveying", New Age International Publishers, Delhi
5. R. Subramanian Surveying and Levelling Oxford University Press
6. W. Schofield Engineering Surveying Elsevier
7. Charles D Ghilani and Paul R Wolf Elementary Surveying Pearson

#### Reference books

1. W. Schofield Engineering Surveying Elsevier
2. Charles D Ghilani and Paul R Wolf Elementary Surveying Pearson

| BCE 214                   |   | FLUID MECHANICS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|---------------------------|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Course category           | : | Professional Core (PC)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Pre-requisite Subject     | : | NIL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Contact hours/week        | : | Lecture : 3, Tutorial : 0 , Practical: 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Number of Credits         | : | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Course Assessment methods | : | Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce, One Minortests, and One Major Theory & Practical Examination                                                                                                                                                                                                                                                                                                                                     |
| Course Objective          | : | <ol style="list-style-type: none"> <li>1. Conceptualize of basic fluid properties including behavior of Newtonian fluid at rest and motion.</li> <li>2. Apply mass, momentum, and energy equation in open channel flow. Estimate velocity distribution, Shear stress distribution and head loss in laminar and turbulent flow in pipes.</li> <li>3. Analyze pipes in series and parallels, and water distribution networks.</li> <li>4. Measure flow through pipes using various flow measuring devices.</li> </ol> |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course Outcomes</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | : | <p>The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course</p> <ol style="list-style-type: none"> <li>1. Understand how to make measurements of flow.</li> <li>2. Understand the type and nature of the flow.</li> <li>3. Apply the principle of momentum, energy, and mass conservation in various fluid flows.</li> <li>4. Explain and describe the difference between smooth and rough surface.</li> <li>5. Figure out the problems in different pipe flows.</li> <li>6. To understand the concept of boundary layer theory and flow separation.</li> </ol> |
| <b>Topics Covered</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>UNIT I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <p><b>Introduction:</b> Fluids and continuum, Fluid Statics, Dimensional Analysis and Model Studies Introduction: Fluids and continuum; Physical properties of fluids: Viscosity, Compressibility, Surface Tension, Capillarity, Vapor Pressure; Cavitation's; Classification of fluids including rheological classification.</p> <p><b>Fluid Statics:</b> Pressure-density-height relationship; Measurement of pressure by Manometers and mechanical gauges; Pressure on plane and curved surfaces; The Hydrostatic law; Total Pressure and Centre of pressure; Buoyancy; Stability of immersed and floating bodies.</p>                                                                                                                                                                                          |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>UNIT II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <p><b>Fluid Kinematics and Fluid Dynamics-I</b></p> <p><b>Fluid Kinematics:</b> Description of Fluid flow: Lagrangian and Eulerian approach; Types of fluid Flows: Steady and unsteady, Uniform and non-uniform, Laminar and turbulent flows, 1, 2 and 3-D flows; Streamlines, Path lines and Streak lines; Stream tube; Acceleration of a fluid particle along a straight and curved path; Differential and Integral form of Continuity equation; Rotation, Vorticity and Circulation; Elementary explanation of Stream function and Velocity potential</p> <p><b>Fluid Dynamics-I:</b> Concept of control volume and control surface, Reynolds Transport Theorem, Introduction to Navier-Stokes Equations, Euler's equation of motion along a streamline and its integration, Free and Forced vortex motion.</p> |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>UNIT III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <p><b>Laminar and Turbulent Flows</b></p> <p><b>Laminar Flow:</b> Reynolds Experiment; Equation of motion for laminar flow through pipes; Flow between parallel plates; Kinetic energy and Momentum correction factors; Stokes law; Flow through porous media; Darcy's Law; Measurement of viscosity.</p> <p><b>Turbulent Flow:</b> Turbulence; Equation for turbulent flow; Reynolds stresses; Eddy viscosity; Mixing length concept and velocity distribution in turbulent flow; Laminar sub-layer; Hydro-dynamically Smooth and rough boundaries; Local and average friction coefficient.</p>                                                                                                                                                                                                                   |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>UNIT IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <p><b>Flow Through Pipes:</b> Nature of turbulent flow in pipes; Major and Minor energy losses; Hydraulic gradient and total energy lines; Flow in sudden expansion, contraction, bends, valves and siphons; Concept of equivalent length; Branched pipes; Pipes in series and parallel; Simple pipe networks and its analysis.</p> <p><b>Compressibility Effects in Pipe Flow:</b> Transmission of pressure waves in rigid and elastic pipes; Water hammer</p>                                                                                                                                                                                                                                                                                                                                                    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>EXPERIMENTS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <ol style="list-style-type: none"> <li>1. To measure the surface tension of a liquid.</li> <li>2. To determine the metacentric height of a ship model experimentally.</li> <li>3. To study the transition from laminar to turbulent flow and to determine the lower critical Reynolds number.</li> <li>4. To determine the coefficients of velocity, contraction, and discharge of an orifice (or a mouthpiece) of a given shape.</li> <li>5. To plot the flow-net for a given model using the concept of electrical analogy.</li> <li>6. To calibrate an orifice meter and venturi meter and to study the variation of the coefficient of</li> </ol>                                                                                                                                                              |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

discharge with the Reynolds number.

7. To calibrate and determine the coefficient of discharge for rectangular and triangular notches.
8. To verify Darcy's law and to find out the coefficient of permeability of the given medium.
9. To verify the momentum equation.
10. To determine the loss coefficients for the various pipe fittings.

**Textbooks**

1. R J Fox: Introduction to Fluid Mechanics
2. Hunter Rouse: Elementary Mechanics of Fluids, John Wiley and sons, Omc/ 1946.
3. L H Shames: Mechanics of Fluids, McGraw Hill, International student edition.
4. Garde, R J and A G Mirajgaonkar: Engineering Fluid Mechanics (including Hydraulic machines), second ed., Nemchand and Bros, Roorkee, 1983.
5. K L Kumar: Engineering Fluid Mechanics
6. Munson, Bruce R, Donald F Young and T H Okishi, Fundamentals of Fluid Mechanics, 2nd Ed, Wiley Eastern.
7. V Gupta and S K Gupta, Fluid Mechanics and its Applications, Wiley Eastern Ltd.
8. Som and Biswas: Introduction to Fluid Mechanics and Machines, TMH.

### Semester IV

| BSM 264                                                                                                                                                                                                                                                                                                                                                                             |   | NUMERICAL METHODS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Course category                                                                                                                                                                                                                                                                                                                                                                     | : | Basic Sciences & Mathematics (BSM)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Pre-requisite Subject                                                                                                                                                                                                                                                                                                                                                               | : | NIL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Contact hours/week                                                                                                                                                                                                                                                                                                                                                                  | : | Lecture: 3, Tutorial : 0 , Practical: 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Number of Credits                                                                                                                                                                                                                                                                                                                                                                   | : | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Course Assessment methods                                                                                                                                                                                                                                                                                                                                                           | : | Continuous assessment through tutorials, attendance, home assignments, quizzes and One Minor tests and One Major Theory & Practical Examination.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Course Objectives                                                                                                                                                                                                                                                                                                                                                                   |   | The objective of this course is to introduce a broad range of numerical methods for solving mathematical problems that arise in science and engineering.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                     | : | After the completion of the course, the students will: <ol style="list-style-type: none"> <li>1. Demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions to otherwise intractable mathematical problems.</li> <li>2. To find the root of a function using Bisection, Regula falsi, Newton's Method, Aitken's method.</li> <li>3. To interpolate a curve using Gauss, Newton's interpolation formula.</li> <li>4. To solve the first order boundary value problem.</li> <li>5. To develop an understanding of the fundamentals in finding the numerical solutions of the system of equations and to find the eigen value of the matrix.</li> <li>6. Demonstrate the concepts of numerical methods used for different applications.</li> </ol> |
| <b>Topics Covered</b>                                                                                                                                                                                                                                                                                                                                                               |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>UNIT I</b>                                                                                                                                                                                                                                                                                                                                                                       |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Roots of equation:</b> Bisection method, Regula Falsi Method, Secant Method, Fixed point Iteration Method, Newton Raphson Method, Modified Newton Raphson Method for Multiple roots, derivation of rate of convergence, Aitken Method.                                                                                                                                           |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>UNIT II</b>                                                                                                                                                                                                                                                                                                                                                                      |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Solutions of system of Linear equations and Eigen Value problem:</b> Linear equations: Direct method for solving systems of linear equations (Gauss elimination, Gauss Jordan, LU Decomposition, Cholesky Decomposition), Iterative methods (Jacobi, Gauss Seidel, Relaxation method). Algebraic Eigen value problem: Power method, Jacobi's method, Given's method.             |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>UNIT III</b>                                                                                                                                                                                                                                                                                                                                                                     |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Interpolations, and Numerical Integration:</b> Relationship in various difference operators, Newton's Forward and Backward Interpolation, Lagrange and Newton divided difference interpolation, Newton's Cotes Formula, Trapezoidal Rule, Simpson's 1/3 and 3/8 rule, Gauss Quadrature Formula, Chebyshev's Formula, Piecewise Linear Interpolation, Cubic Spline Interpolation. |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>UNIT IV</b>                                                                                                                                                                                                                                                                                                                                                                      |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Numerical solution of Ordinary differential equations, and Difference Equation:</b> Single Step Methods: Taylor, Picard, Euler, Modified Euler, and Runge-Kutta Fourth Order Methods. Multistep methods: Milne's and Adam's predictor and corrector methods. Difference equations and their solutions, Rules for finding the particular integral.                                |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>EXPERIMENTS</b>                                                                                                                                                                                                                                                                                                                                                                  |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <ol style="list-style-type: none"> <li>1. To implement Regula-Falsi method to find root of algebraic equation.</li> <li>2. To implement Newton-Raphson method to find root of algebraic equation.</li> <li>3. To implement Newton's Divided Difference formula to find value of a function at a point.</li> </ol>                                                                   |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

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| 4. To implement Numerical Integration by using Simpson's one-third rule.                           |
| 5. To implement numerical solution of differential equation by Picard's method.                    |
| 6. To implement numerical solution of differential equation by using Euler's method.               |
| To implement numerical solution of differential equation by using Runge – Kutta Method.            |
| <b>Books &amp; References</b>                                                                      |
| 1. M.K. Jain, S.R.K. Iyenger and R.K. Jain, Numerical Methods:, New Age Publishers.                |
| 2. P. Kandasamy, K.Thilagavathi, K.Gunavathi , <i>Numerical Methods.</i> , S. Chand & Company.     |
| 3. B.S. Grewal; Higher Engineering Mathematics, Khanna Publishers, Delhi.                          |
| 4. B.V. Ramana; Higher Engineering Mathematics, Tata Mc. Graw Hill Education Pvt. Ltd., New Delhi. |
| 5. Brian Bradie, A Friendly Introduction to Numerical Analysis, Pearson Education, Asia, New Delhi |

| BCE 261                                                                                                                                                                                                                                                                                                                                           |   | HYDRAULIC AND HYDRAULIC MACHINES                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| Course category                                                                                                                                                                                                                                                                                                                                   | : | Professional Core (PC)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |  |
| Pre-requisite Subject                                                                                                                                                                                                                                                                                                                             | : | Fluid Mechanics (BCE-214)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |  |
| Contact hours/week                                                                                                                                                                                                                                                                                                                                | : | Lecture : 3, Tutorial : 0 , Practical: 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |  |
| Number of Credits                                                                                                                                                                                                                                                                                                                                 | : | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |
| Course Assessment methods                                                                                                                                                                                                                                                                                                                         | : | Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce, One Minor tests, and One Major Theory & Practical Examination                                                                                                                                                                                                                                                                                                                                                                                                   |  |
| Course Objective                                                                                                                                                                                                                                                                                                                                  | : | 1. Classify open channel flow and compute velocity distribution and pressure distribution in open channel flow.<br>2. Compute normal and critical depth and design of efficient channel.<br>3. Identify and compute backwater and drawdown profiles in open channel encountered in water resources project.<br>4. Study of characteristics and types of hydraulic jumps.<br>5. Locate the hydraulic jump encountered in design of hydraulic structures in an open channel.<br>6. Select and design hydraulic machines such as pumps and Turbines based on the system requirements. |  |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                   | : | The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this Course.                                                                                                                                                                                                                                                                                                                                                                                                                                                   |  |
|                                                                                                                                                                                                                                                                                                                                                   |   | 1. To identify the different types of flow in Open Channel.<br>2. To understand the concept of Hydraulic Jump.<br>3. To classify the various types of flow profiles<br>4. To study the characteristics of rotodynamic Pumps.<br>5. To understand the working of Turbines.<br>6. To have throughout knowledge on selection of turbines and pumps for practical purposes.                                                                                                                                                                                                            |  |
| Topics Covered                                                                                                                                                                                                                                                                                                                                    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |  |
| UNIT I                                                                                                                                                                                                                                                                                                                                            |   | 9                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |
| <b>Introduction:</b> Difference between open channel flow and pipe flow, geometrical parameters of a channel, continuity equation. Critical depth, concepts of specific energy and specific force, application of specific energy principles for the interpretation of open channel phenomena, flow through vertical and horizontal contractions. |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |  |
| <b>Uniform Flow:</b> Chazy's and Manning's equations for uniform flow in an open channel, factors                                                                                                                                                                                                                                                 |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |  |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |          |
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| affecting Manning's coefficient "n", Velocity distribution, Velocity distribution coefficients, most efficient channel section                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |          |
| <b>UNIT II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>9</b> |
| <b>Gradually Varied Flow:</b> Equation of gradually varied flow and its limitations, flow classification and surface profiles, integration of varied flow equation by graphical and numerical method and analytical and analysis of water surface profiles.                                                                                                                                                                                                                                                                                                                                                                                                  |          |
| <b>UNIT III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>9</b> |
| <b>Rapidly Varied Flow:</b> Classical hydraulic jump, evaluation of the jump elements in rectangular and non-rectangular channels on horizontal and sloping beds, open channel surge, celerity of the gravity wave.                                                                                                                                                                                                                                                                                                                                                                                                                                          |          |
| <b>Hydraulic Pumps:</b> Rotodynamic pumps, classification on different basis, basic equations, Velocity triangles, manometric head, efficiencies, cavitation in pumps, characteristics curves.                                                                                                                                                                                                                                                                                                                                                                                                                                                               |          |
| <b>UNIT IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>9</b> |
| <b>Hydraulic turbines:</b> Introduction, Rotodynamic Machines, Impulse turbines, Pelton Turbine, equations for jet and rotor size, efficiency, spear valve, reaction turbines, Francis and Kaplan type, Head on reaction turbine, unit quantities, similarity laws and specific speed, cavitation, characteristic curves                                                                                                                                                                                                                                                                                                                                     |          |
| <b>EXPERIMENTS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |          |
| <ol style="list-style-type: none"> <li>1. To determine the Manning's roughness coefficient "n" for the given flume.</li> <li>2. To determine the Chezy's coefficient "C" for the given flume.</li> <li>3. To study the flow characteristics over a hump placed in an open channel.</li> <li>4. To study the flow through a horizontal contraction in a rectangular channel.</li> <li>5. To calibrate a broad-crested weir.</li> <li>6. To study the characteristics of free hydraulic jump.</li> <li>7. To study rotodynamic pumps and their characteristics</li> <li>8. To study characteristics of reaction turbines (Francis/ Kaplan / Pelton)</li> </ol> |          |
| <b>Textbooks</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |          |
| <ol style="list-style-type: none"> <li>1. Jain A.K., Fluid Mechanics including Hydraulic Machine, Khanna publisher, 8th edition.</li> <li>2. Modi P.N and S. M Seth, Hydraulics and Fluid Mechanics including Hydraulic machines, Standard BookPub; New Delhi.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                    |          |
| <b>Reference Books</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |          |
| <ol style="list-style-type: none"> <li>1. Garde, R.J., "Fluid Mechanics through Problems", New Age International</li> <li>2. Streeter, V.L. and White, E.B., "Fluid Mechanics", McGraw Hill, New York, 8th</li> <li>3. Asawa, G.L., "Experimental Fluid Mechanics", Vol.1, Nem Chand and Bros.,</li> <li>4. Ranga Raju, K.G., Flow through open channels, T.M.H. 2nd edition</li> <li>5. Rajesh Srivastava, Flow through Open Channels, Oxford University Press.</li> <li>6. K. Subramanya, Flow through Open Channels, TMH</li> <li>7. Vasundani, Hydraulic Machines</li> </ol>                                                                             |          |

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|----------------------------------|----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>BCE 262</b>                   | <b>STRUCTURAL ANALYSIS</b> |                                                                                                                                                                                                                                                               |
| <b>Course category</b>           | :                          | Professional Core (PC)                                                                                                                                                                                                                                        |
| <b>Pre-requisite Subject</b>     | :                          | Structural Mechanics                                                                                                                                                                                                                                          |
| <b>Contact hours/week</b>        | :                          | Lecture: 3, Tutorial : 1 , Practical: 0                                                                                                                                                                                                                       |
| <b>Number of Credits</b>         | :                          | 4                                                                                                                                                                                                                                                             |
| <b>Course Assessment methods</b> | :                          | Continuous assessment through tutorials, assignments, quizzes and one Minor tests and One Major Theory Examination.                                                                                                                                           |
| <b>Course Objectives</b>         | :                          | <p>The main objectives of the course are:</p> <ol style="list-style-type: none"> <li>1. To impart the principles of elastic structural analysis and behaviour of indeterminate structures and to get a feeling of how real-life structures behaves</li> </ol> |



|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |   | 2. To enable the student to get the knowledge about various methods involved in the analysis of indeterminate structures and apply those methods to evaluate the response of structures.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Course Outcomes</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | : | <p>The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course</p> <ol style="list-style-type: none"> <li>1. Understand the concept of structural systems, loads, supports and displacements, statically determinate and indeterminate structural systems.</li> <li>2. Apply a suitable analysis technique for statically indeterminate structures.</li> <li>3. Analyze the beams and frames using the Classical Methods of analysis.</li> <li>4. Develop and use the concept of influence line diagram for calculating maximum values of different structural quantities in a statically determinate structure, like BM, SF and displacement.</li> <li>5. Compute reactive forces in the two hinged and three hinged arches using Conventional Methods of analysis of structures.</li> <li>6. Evaluate the plastic behaviour of structural system based on the plastic theory</li> </ol> |
| <b>Topics Covered</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>UNIT I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Indeterminacy: static and Kinematic, Analysis of Indeterminate structures: Analysis of fixed beams, Continuous beams, and simple frames with and without translation of joint, Method of Consistent Deformation, Slope-Deflection method, Moment Distribution method, Strain Energy method.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>UNIT II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Moving loads for determinate beams: Different load cases, Influence lines for forces for determinate beams; Influence lines for indeterminate beams using Muller Breslau principle. Absolute maximum bending moment.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>UNIT III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Analysis of Arches, Linear arch, Eddy's theorem, three hinged parabolic and circular arch, two hinged arch, spandrel braced arch, Influence lines for Arches and stiffening girders, Influence line diagrams for maximum bending moment, Shear force and thrust.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>UNIT-IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Basics of Plastic Analysis, Plastic moment of resistance, Plastic section modulus, Shape factor, Load factor, Plastic hinge and mechanism, Plastic analysis of indeterminate beams and frames – Upper and lower bound theorems.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Textbooks</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <ol style="list-style-type: none"> <li>1. Theory and Analysis of Structures, Vol. I &amp; II - O. P. Jain &amp; B. K. Jain, Nem Chand &amp; Bros., Roorkee.</li> <li>2. Wang, C.K., Intermediate Structural Analysis, McGraw Hill.</li> <li>3. Analyse Devadas Menon, "Structural Analysis", Narosa Publishing House, 2008.</li> <li>4. Hibbeler, R.C., Structural Analysis, 7th ed. East Rutherford, NJ: Pearson Prentice Hall, 2008.</li> </ol>                                                                                                                                                                                                                                                                                                                                                               |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Reference Books</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <ol style="list-style-type: none"> <li>1. Theory of Structures - S. P. Timoshenko and D. Young, McGraw Hill Book Publishing Company Ltd., New Delhi</li> <li>2. Reddy. C.S., "Basic Structural Analysis", Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2013.</li> <li>3. Introduction to Matrix Methods of Structural Analysis by H. C. Martin, McGraw Hill Book Publishing Company Ltd.</li> <li>4. Matrix Analysis of Framed Structures - Weaver and Gere.</li> <li>5. Theory of Structures Vol. II - Vazirani &amp; Ratwani.</li> <li>4. Influence Line Diagrams - Dhavilkar.</li> <li>6. Analysis of Statically Indeterminate Structures - P. Dayaratnam, Affiliated East- West Press.</li> <li>7. Norris, C.H., Wilbur, J.B., and Utku, S., Elementary Structural Analysis, TMH, 2003, 1983</li> </ol> |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

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| <b>BCE 263</b>                                                                                                                                                                                                                                                                                                                                                                                 | <b>HIGHWAY ENGINEERING</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Course category</b>                                                                                                                                                                                                                                                                                                                                                                         | :                          | Professional Core (PC)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Pre-requisite Subject</b>                                                                                                                                                                                                                                                                                                                                                                   | :                          | NIL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Contact hours/week</b>                                                                                                                                                                                                                                                                                                                                                                      | :                          | Lecture:3, Tutorial: 0, Practical:2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Number of Credits</b>                                                                                                                                                                                                                                                                                                                                                                       | :                          | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Course Assessment methods</b>                                                                                                                                                                                                                                                                                                                                                               | :                          | Continuous assessment through attendance, home assignments, quizzes, practical work, record, viva voce and one Minor tests and One Major Theory & Practical Examination                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Course Objectives</b>                                                                                                                                                                                                                                                                                                                                                                       | :                          | <ol style="list-style-type: none"> <li>1. To introduce the students with the principles and practice of transportation engineering which focuses on Traffic and Transportation Engineering and Highway Engineering.</li> <li>2. To enable the students to have a strong analytical and practical knowledge of Planning, Designing, and solving the transportation problems.</li> <li>3. To introduce the recent advancements in the field of Sustainable Urban Development, Traffic Engineering and Management, Systems Dynamics Approach to Transport Planning, Highway Design and Construction, Economic and Environment Evaluation of Transport Projects.</li> <li>4. To strength the students' knowledge and technical know-how to be efficient Transport Engineers.</li> </ol> |
| <b>Course Outcomes</b>                                                                                                                                                                                                                                                                                                                                                                         | :                          | <p>The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course</p> <ol style="list-style-type: none"> <li>1. Understanding the types of pavements and their components.</li> <li>2. Materials used for highway construction.</li> <li>3. Methods of design of flexible and rigid pavement including IRC method.</li> <li>4. Construction and maintenance of different types of pavements</li> <li>5. Basic concept about highway engineering</li> <li>6. Various types of intersection and their suitability.</li> </ol>                                                                                                                                                                                        |
| <b>Topics Covered</b>                                                                                                                                                                                                                                                                                                                                                                          |                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>UNIT I</b>                                                                                                                                                                                                                                                                                                                                                                                  |                            | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Introduction: Role of transportation, Mode of transportation, History of road development, Nagpur Road plan, Bombay Road plan & 3rd 20-Year-Old Road Plan, Road Types and Pattern. Geometric design: cross-sectional elements, camber, shoulder, sight distance, horizontal curves, super elevation, extra widening, transition curves and gradient, vehicle curves, summit, and valley curves |                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>UNIT II</b>                                                                                                                                                                                                                                                                                                                                                                                 |                            | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Traffic Engineering: Traffic characteristic, volume studies, speed study, capacity, density, traffic control devices, signs, signals, design of signals, Island, Intersection at grade and grade separated intersections, design of rotary intersection.                                                                                                                                       |                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>UNIT III</b>                                                                                                                                                                                                                                                                                                                                                                                |                            | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Design of Highway Pavement: Types of pavements, Design factors, Design of flexible pavements by CBR method (IRC: 37-2001, 2012 and 2018), Design of rigid pavement, Westergaard theory, load and temperature stresses, joints, IRC method of rigid pavement design. (IRC 58-2002, 2011 and 2015).                                                                                              |                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>UNIT IV</b>                                                                                                                                                                                                                                                                                                                                                                                 |                            | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Road Construction Methods: WBM, WMM, Surface Dressing, Bituminous carpeting, Bituminous Bound Macadam and Asphaltic Concrete, Cement Concrete Road construction.                                                                                                                                                                                                                               |                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>List of EXPERIMENTS</b>                                                                                                                                                                                                                                                                                                                                                                     |                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <ol style="list-style-type: none"> <li>1. Impact value test of Aggregate</li> <li>2. Shape test (Flakiness, Index, Elongation Index) of Aggregate</li> </ol>                                                                                                                                                                                                                                   |                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

3. Crushing value test of Aggregates
4. Los Angeles Abrasion Value test for Aggregate
5. Stripping test of Bituminous Sample.
6. Ductility test of Bituminous Sample
7. Penetration test of Bituminous Sample
8. Softening point test of Bituminous sample
9. Flash and Fire Test of Bituminous Sample
10. Classified Both directional Traffic Volume study
11. Traffic speed study (using radar speedometer).
12. Determination of Marshall Stability Value
13. CBT Test for soil
14. Proctor Test for soil

#### **Textbooks**

1. Highway Engineering by S. K. Khanna and C.E.G. Justo, Nem Chand & brothers, Roorkee.
2. Traffic Engineering by L. R. Kadiyali, Khanna Publishers, New Delhi.
3. Principles of Transportation and Highway Engineering by G.V. Rao, Tata McGraw Hill, New Delhi.
4. Highway and Traffic Engineering by Subhash C. Saxena, CSB Publishers and Distributors Ltd. New Delhi.

#### **Reference books**

1. Transportation Engineering by James S. Banks Tata McGraw Hill, New Delhi.
2. Transportation Engg. by Papakosta and P.D. Prevedouros, Prentice Hall India, New Delhi.
3. Principles of Transportation Engineering by P. Chakraborti and A. Das, Prentice Hall India, New Delhi.
4. Highway Material Testing S.K. Khanna and C.E.G. Justo. 5. Highway Material Testing by A.K. Duggal.

## Semester – V

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| <b>BCE 301</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>FOUNDATION ENGINEERING</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Course category</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | :                             | Professional Core (PC)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Pre-requisite Subject</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | :                             | Soil Mechanics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Contact hours/week</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | :                             | Lecture : 3, Tutorial : 1 , Practical: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Number of Credits</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | :                             | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Course Assessment methods</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | :                             | Continuous assessment through tutorials, attendance, home assignments, quizzes and One Minor Test and One Major Theory Examination                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Course Objectives</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | :                             | To enable students to understand soil exploration and in-situ testing techniques, lateral earth pressure and retaining systems, shallow foundation design and settlement behaviour, and pile foundation performance, including soil–pile interaction.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Course Outcomes</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | :                             | <p>The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course</p> <ol style="list-style-type: none"> <li>1. Explain and select appropriate soil exploration, sampling, and in-situ testing techniques for geotechnical site characterization.</li> <li>2. Analyze arching behaviour and compute lateral earth pressures using Rankine and Coulomb earth pressure theories.</li> <li>3. Evaluate the stability and performance of retaining structures, including reinforced earth walls.</li> <li>4. Apply bearing capacity theories and settlement analysis methods for the design of shallow foundations.</li> <li>5. Assess pile foundation performance considering axial, lateral, and uplift loading conditions.</li> <li>6. Interpret field test results and apply them in practical geotechnical design and decision-making.</li> </ol> |
| <b>Topics Covered</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>UNIT-I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                               | 9                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Introduction to soil exploration, planning of soil exploration, methods of exploration and boring, soil sampling and samplers, sampling methods and sample disturbance, trial pits and borehole planning, depth of exploration, field versus laboratory testing, Penetration test, SPT, SCPT, DCPT, penetrometer testing, pressure meter testing, geophysical methods, rock coring, borehole logging, soil exploration reporting.                                                                                                                                           |                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>UNIT-II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                               | 9                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Arching in soils, theories of arching, braced excavations, earth pressure against bracings in cuts, heave of the bottom of cuts in soft clays.<br>Concept of lateral earth pressure: at-rest, active, and passive pressures; Rankine's theory of active and passive pressure; Generalized case for Rankine active and passive pressures; Rankine's pressure for $c'-\phi'$ soil with inclined backfill; Coulomb's active & passive pressure; Graphical solution for Coulomb's active earth pressure; and common types of retaining walls, including reinforced earth walls. |                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>UNIT-III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                               | 9                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Introduction to shallow foundations, bearing capacity of shallow foundations, settlement of shallow foundations, allowable bearing pressure, proportioning of footings, ultimate soil-bearing capacity concepts, Terzaghi's bearing capacity equation, effect of groundwater table, factor of safety in foundation design, generalized bearing capacity equation.                                                                                                                                                                                                           |                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>UNIT-IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                               | 9                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Introduction to pile foundations, uses and types of piles, pile construction, pile driving methods, pile load capacity in compression, static pile load formulae, load testing on piles, dynamic pile formulae, correlation with penetration test data, group action of piles, negative skin friction, laterally loaded piles, and piles subjected to uplift loads.                                                                                                                                                                                                         |                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

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| <b>Textbooks</b>       |                                                                                                                |
| 1.                     | K.R. Arora — <i>Soil Mechanics and Foundation Engineering</i> , Standard Publishers & Distributors, New Delhi. |
| 2.                     | Alam Singh — <i>Modern Geotechnical Engineering</i> , Asia Publishing House, New Delhi.                        |
| 3.                     | Gopal Ranjan and A.S.R. Rao — <i>Basic and Applied Soil Mechanics</i> , New Age International (P) Ltd.         |
| <b>Reference Books</b> |                                                                                                                |
| 1.                     | Braja M. Das — <i>Principles of Geotechnical Engineering</i> , Cengage Learning.                               |
| 2.                     | I.H. Khan — <i>Textbook of Geotechnical Engineering</i> , Prentice-Hall of India Ltd., New Delhi.              |
| 3.                     | C. Venkataramaiah — <i>Geotechnical Engineering</i> , New Age International (P) Ltd., New Delhi.               |
| 4.                     | J.E. Bowles — <i>Foundation Analysis and Design</i> , McGraw-Hill, New Delhi.                                  |
| 5.                     | V.N.S. Murthy — <i>Soil Mechanics and Foundation Engineering</i> , CBS Publishers & Distributors.              |

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| <b>BCE 302</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>WATER AND WASTEWATER ENGINEERING</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Course category</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                   | : Professional Core (PC)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Pre-requisite Subject</b>                                                                                                                                                                                                                                                                                                                                                                                                                                             | : NIL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Contact hours/week</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                | : Lecture : 3; Tutorial : 0; Practical: 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Number of Credits</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                 | : 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Course Assessment methods</b>                                                                                                                                                                                                                                                                                                                                                                                                                                         | : Continuous assessment through attendance, home assignments, quizzes, viva voce, One Minor Test, and One Major Theory and Practical Examination                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Course Objectives</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                 | : To make the students understand the quality parameters of water for various application and treatment of waste water.                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Course Outcomes</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                   | : The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course<br>1. Design the water supply and wastewater treatment systems.<br>2. Determine the treatment efficiency of treatment units<br>3. Determining water quality parameters<br>4. Methods for determining wastewater quality parameters<br>5. Methods for forecasting population and estimating water demand and waste water generation<br>6. Knowledge about working of wastewater treatment methods |
| <b>Topics Covered</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>UNIT I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Water treatment plant: Layout plan and section of water treatment plant, Estimation of raw water discharge for treatment plant, Design period, and factors considered for selection of design period. Treatment plant site selection, factors considered, future stages of expansion, selection of treatment train. Collection and conveyance of raw water from source: Intakes, types of intakes, conveyance of water, design of pumps and gravity and rising mains     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>UNIT II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Water treatment processes and treatment units: Plain sedimentation, aeration, sedimentation tank & its design, sedimentation with coagulation, types of coagulants, optimum dose of coagulants, mixing devices, design of flocculation unit. theory of filtration, types of filters and their comparison, design of rapid sand filter, washing of filter, methods of disinfection, methods of removing hardness Computation of dose of chemicals for removal of hardness |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>UNIT III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Collection of sewage & estimation of its discharge: Different types of sewers, sewerage systems, variation in sewage flow, sewer appurtenance, estimation of wastewater discharge in a sewer in sewerage system, estimation of storm water discharge in urban area, separate and combined sewerage systems, laying and testing of sewers.                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>UNIT IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

Unit operations/ processes for wastewater treatment: Layout plan and section of municipal wastewater treatment plant, Physical unit operation screening, flow equalization, mixing, flocculation, sedimentation. Chemical unit processes-chemical precipitation. Biological unit processes: Aerobic attached growth and aerobic suspended growth treatment processes, anaerobic suspended growth treatment processes, an aerobic suspended growth treatment processes, low cost sanitation systems, septic tanks, soak pit, stabilization ponds.

#### List of Experiments

1. Determination of pH Value of a given water sample.
2. Determination of Acidity in water Sample.
3. Determination of Alkalinity in water Sample.
4. Determination of Chlorides in a given water Sample.
5. Determination of Total Hardness and Carbonate Hardness in a given water sample.
6. Determination of Dissolved Oxygen (D.O.) in a given water sample.
7. Determination of Total Solids, Suspended & Dissolved Solids in a given water sample.
8. Determination of Sulphate in a given water sample.
9. Determination of Turbidity in a given water sample by Nephelo-Turbidimeter.
10. Determination of Coli-form Bacteria in a given water sample by Most Probable Number (M.P.N.) test.
11. Determination of Chemical Oxygen Demand (COD) of a given sample of sewage.
12. 12. Determination of Bio-Chemical Oxygen demand (BOD) of a given sample of sewage.

#### Reference Books

1. Environmental engineering volume 1 and 2 by S.K.Garg, Khanna publisher 2.
2. Water supply and sanitary engineering by G.S.Birdie and J.S.Birdie
3. Environmental pollution engineering by C.S. Rao wiley eastern
4. Water supply and wastewater engineering by B.S.N Raju, Tata McGraw hill, New Delhi
5. H.S. Peavy, D.R.Row & G.Tchobanoglous, environmental engineering,Mc Graw Hill Intranational Edition
6. Viesman, Hammer and Chadik, water supply and pollution control, PHI Publication.
7. M.L.Devis and D.A.Cornwell,Introduction to environmental engineering:-2nd edition-1997,Mc Graw Hill Intranational Edition
8. Metcalf and eddy,(revised by G.Tchobanoglous) Wastewater Engineering: Treatment, disposal reuse, Tata-Mc Graw Hill, New Delhi

| BCE 303                   |   | DESIGN OF CONCRETE STRUCTURES                                                                                                                                                                                                                                                                                                                                                        |
|---------------------------|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Course category           | : | Professional Core (PC)                                                                                                                                                                                                                                                                                                                                                               |
| Pre-requisite Subject     | : | Engineering Geology & Building Material (BCE-152)                                                                                                                                                                                                                                                                                                                                    |
| Contact hours/week        | : | Lecture: 3, Tutorial: 0, Practical: 2                                                                                                                                                                                                                                                                                                                                                |
| Number of Credits         | : | 4                                                                                                                                                                                                                                                                                                                                                                                    |
| Course Assessment methods | : | Continuous assessment through, attendance, home assignments, quizzes, practical work, record, viva voce and One Minor Test and One Major Theory & Practical Examination                                                                                                                                                                                                              |
| Course Objectives         | : | To introduce the students to the fundamentals of reinforced concrete design with emphasis on the design of rectangular and T beams, short and slender columns, slabs, and footings and foundations. In addition, student will learn how to analyze and design reinforced concrete structural members under bending, shear, and/or axial loads according to the IS code requirements. |

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|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course Outcomes</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | : | <p>The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course</p> <ol style="list-style-type: none"> <li>1. Understand various philosophies for design of reinforced concrete.</li> <li>2. Design one way and two-way slab by limit state method.</li> <li>3. Understand the provisions of IS 456:2000 for design of R.C.C. Columns with and without eccentricity.</li> <li>4. To use Design Chart for design of columns subjected to uni- axial biaxial bending</li> <li>5. Know the method of pre-stressing, their advantages, and losses in pre-stress.</li> <li>6. Able to analyse pre-stressed rectangular and T-section.</li> </ol> |
| <b>Topics Covered</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>UNIT I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |   | 9                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Nature of Stresses in flat slabs with and without drops, coefficient for design of flat slabs, reinforcement in flat slabs. (IS Code Method). Structural behaviour of footings, design of footing for a wall and a single column, combined rectangular and trapezoidal footings, Design of strap footing.                                                                                                                                                                                                                                                                                                                     |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>UNIT II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |   | 9                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Structural behaviour of retaining wall, stability of retaining wall against overturning and sliding, Design of T-shaped retaining wall, Concept of Counter fort retaining wall. Loads, forces and I.R.C. bridge loadings, Design of R.C. slab culvert.                                                                                                                                                                                                                                                                                                                                                                        |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>UNIT III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |   | 9                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Design criteria, material specifications and permissible stresses for tanks, design concept of circular and rectangular tanks situated on the ground / underground, design of overhead tanks.                                                                                                                                                                                                                                                                                                                                                                                                                                 |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>UNIT IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |   | 9                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Advantages of pre-stressing, methods of pre-stressing, losses in pre-stress, analysis of simple prestressed rectangular and T-section                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>LIST OF EXPERIMENTS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <ol style="list-style-type: none"> <li>1. Comparison of strength of cylinder and cube strength of concrete.</li> <li>2. Modulus of rupture of concrete.</li> <li>3. Study of admixtures and their effect on workability.</li> <li>4. Study of effect of w/c ratio on strength of concrete.</li> <li>5. Study of variation of strength of cement concrete and determination of standard deviation and gradation of concrete.</li> <li>6. Study and draw compression test diagram of concrete.</li> <li>7. To determine quality/ strength of concrete by using Rebound hammer/ Ultrasonic pulse velocity instruments</li> </ol> |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Textbooks and References</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <ol style="list-style-type: none"> <li>1. Nilson, A. H. Design of Concrete Structures. 13th edition. McGraw Hill, 2004</li> <li>2. Wang C-K. and Salmon, C. G., Reinforced Concrete Design, 6th Edition, Addison Wesley, New York</li> <li>3. Fundamentals of Reinforced Concrete by M L Gambhir, PHI 4. IS:456-2000, IS:10262-2009</li> <li>4. Concrete Structure – Limit State Design by A.K. Jain, Nem Chand &amp; Bros</li> <li>5. Reinforced Concrete Design by S. Unnikrishna Pillai &amp; D. Menon, Tata McGraw.</li> </ol>                                                                                            |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

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|----------------------------------|---------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>BHS 303/353</b>               | <b>INDUSTRIAL/ORGANIZATIONAL PSYCHOLOGY</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Course category</b>           | :                                           | HSSE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Pre-requisite Subject</b>     | :                                           | NIL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Contact hours/week</b>        | :                                           | Lecture:3, Tutorial:1, Practical:0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Number of Credits</b>         | :                                           | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Course Assessment methods</b> | :                                           | Continuous assessment through One test, teacher's assessment (quiz, tutorial.assignment, attendance), and One Major Theory Examination.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Course Objectives</b>         | :                                           | <ol style="list-style-type: none"> <li>1. I. Provide students with a foundational understanding of the principles. theories, and research methods in the field of I/O psychology.</li> <li>2. To help students to understand the process of personnel management (selection. training, performance appraisal, development) while also introducing the psychological assessment methods crucial for effective personnel selection, job analysis, and employee evaluation.</li> <li>3. To help students to analyse the multifaceted influences on workplace behaviour (motivation, job satisfaction, leadership dynamics, organizational culture) and to explore organizational dynamics (structure, communication patterns, decision-making processes), and strategies for effective change management.</li> <li>4. To provide opportunities for students to apply I/O psychology principles to real-world scenarios.</li> </ol> |
| <b>Course Outcomes</b>           | :                                           | <p>The students will be able to demonstrate the following knowledge, skills, and attitudes upon completion of the course: -</p> <ol style="list-style-type: none"> <li>1. I . Demonstrate a clear understanding of key concepts and theories in the field of I/O psychology, including their historical development and contemporary relevance.</li> <li>2. 2. Identify and propose solutions to workplace problems using evidencebased approaches grounded in I/O psychology principles.</li> <li>3. Apply knowledge and skills acquired in the course to real-world situations. such as improving employee performance, enhancing team effectiveness. and promoting organizational change.</li> <li>4. Demonstrate awareness of ethical issues and professional standards. and apply ethical principles to decision-making in the workplace</li> </ol>                                                                        |
| <b>Topics Covered</b>            |                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>UNIT I</b>                    |                                             | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |



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|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
| Introduction to Industrial Psychology: Definition, scope, brief history, various sub divisions; Research in Industrial Psychology; Scientific Management Theory; Human Relations School; Managerial Roles, Functions & Skills; Effective vs Successful managers; Job Analysis and Evaluation; Employee Selection: Recruitment, Realistic Job Previews, Effective Employee Selection Techniques, Job Search Skills; Employee Selection: References and Testing.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |   |
| <b>UNIT II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 9 |
| Evaluating Employee Performance; Designing & Evaluating Training Systems; Performance Management: Employee Retention, Engagement, and Careers; Organizational Development and Change Management: Employee Relations: Ethics and Employee Rights, Labor Relations and Collective Bargaining, Managing Global Human Resources, Managing Human Resources in Small and Entrepreneurial Firms.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |   |
| <b>UNIT III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 9 |
| Motivation: Concept, theories and application; Emotions at workplace; Attitudes and Job Satisfaction; Perception: Components, process, factors that influence it, person perception, individual decision making; Personality: Determinants, theories and measurement; Stress: Sources, consequences and management'                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |   |
| <b>UNIT IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 9 |
| Foundations of Group Behavior: Types groups, properties, decision making in groups; Understanding work teams: Types, creating effective teams; Communication: Functions, process, modes and organizational communication; Leadership: Concept, theories, finding and creating effective leaders; Power & Politics; Conflict & Negotiation.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |   |
| <b>Textbooks</b> <ol style="list-style-type: none"> <li>1. Aamodt, M. G. (2010). Industrial/Organizational Psychology: An Applied Approach. Wadsworth Cengage Learning.</li> <li>2. Aswathappa, K. (2008). Human Resource Management. Tata McGraw Hill.</li> <li>3. Chitale, A. K., Mohanty, R. P., &amp; Dubey, N. R. (2019). Organizational Behavior: Text and Cases. Prentice Hall India.</li> <li>4. Dessler, G., &amp; Varrkey, B. (2020). Human Resource Management. Pearson.</li> <li>5. Luthans, F. (2010). Organizational Behavior. McGraw Hill.</li> <li>6. McShane, S. Glinow, M. A. V., &amp; Rai, H. (2022). Organizational Behavior. McGraw Hill.</li> <li>7. Muchinsky, P. M. (2006). Psychology applied to work: An introduction to industrial and organizational psychology. Hypergraphic Press.</li> <li>8. Pareek, U. (2004). Understanding Organisational Behaviour. Oxford University Press.</li> <li>9. Robbins, S. P., Judge, T.A., &amp; Volumni, N. (2019). Organizational Behavior. Pearson.</li> </ol> |   |

## Semester VI

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| <b>BCE 351</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>DESIGN OF AIRPORT, DOCKS AND HARBOR</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Course category</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | : Professional Core (PC)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Pre-requisite Subject</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | : NIL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Contact hours/week</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | : Lecture : 3; Tutorial : 1; Practical: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Number of Credits</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | : 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Course Assessment methods</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | : Continuous assessment through tutorials, attendance, home assignments, quizzes, viva voce, One Minor Test, and One Major Theory Examination                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Course Objectives</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | : To introduce the students about airport planning, design, construction and planning design principles of seaport.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Course Outcomes</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | : The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course <ol style="list-style-type: none"> <li>1. Gain an insight on the planning and site selection of Airport Planning and design.</li> <li>2. Knowledge on Design of various Airport components.</li> <li>3. Analyze and design the elements for orientation of runways and passenger facility systems.</li> <li>4. Understand the various features in Harbors and Ports, their construction, coastal protection works.</li> <li>5. Knowledge on various Environmental Regulations and Acts.</li> <li>6. Knowledge about sea port regulations and EIA</li> </ol> |
| <b>Topics Covered</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>UNIT I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Airport Planning: Air transport characteristics - airport classification – ICAO - airport planning: Site selection typical Airport Layouts, Case Studies, parking and Circulation Area<br>Airport Components: Airport Classification, Planning of Airfield Components – Runway, Taxiway, Apron, Hangar- Passenger Terminals- Geometric design of runway and taxiways-Runway pavement Design- Difference between Highway and airport pavements- Introduction to various design methods- Airport drainage.                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>UNIT II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Airport Design: Runway Design: Orientation, Wind Rose Diagram, Problems on basic and Actual Length, Geometric Design – Elements of Runway Design – Airport Zones – Passenger Facilities and Services – Runway and Taxiway Markings- Air Traffic Airport Classification, Planning of Airfield Components – Runway, Taxiway, Apron, Hangar- Passenger Terminals- Geometric design of runway and taxiways; Runway pavement Design- Difference between Highway and airport pavements- Introduction to various design methods- Airport drainage. Control Tower- Instrumental Landing. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>UNIT III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Seaport Components and Construction: Definition of Basic Terms: Harbor, Port, Satellite Port, Docks- Dry and Floating Dock, Waves and Tides – Planning and Design of Harbors: Harbour Layout and Terminal Facilities – Coastal Structures: Piers, Break waters, Wharves, Jetties, Quays, Spring Fenders, Dolphins Floating Landing Stage – Navigational Aids-Inland Water Transport.                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>UNIT IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Seaport Regulations and EIA: Wave action on Coastal Structures and Shore Protection and Reclamation – Coastal Regulation Zone, 2011-EIA – methods of impact analysis and its process                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Textbooks</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <ol style="list-style-type: none"> <li>1. 1. Khanna.S.K. Arora.M.G and Jain.S.S, Airport Planning and Design, Nemachand and Bros, Roorkee,1994</li> <li>2. Robert Honjeff and Francis X.Mckelvey, "Planning and Design of Airports", McGraw Hill, New York,1996 2. Richard De Neufille and Amedeo Odoni, "Airport Systems Planning and Design", McGraw Hill, New York,2003</li> <li>3. Subramanian K.P., Highways, Railways, Airport and Harbour Engineering, Sci-tech Publications (India), Chennai, 2010</li> </ol>                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Reference Books</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <ol style="list-style-type: none"> <li>1. Venkatramaiah. C., Transportation Engineering-Vol.2 Railways, Airports, Docks and Harbours,</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

- Bridges and Tunnels., Universities Press (India) Private Limited, Hyderabad, 2015.
2. Mundrey J S, Railway Track Engineering, McGraw Hill Education ( India) Private Ltd, New Delhi, 2013.

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| <b>BCE 352</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>CONSTRUCTION TECHNOLOGY AND MANAGEMENT</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Course category</b>                                                                                                                                                                                                                                                                                                                                                                                                                                           | :                                             | Professional Core (PC)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Pre-requisite Subject</b>                                                                                                                                                                                                                                                                                                                                                                                                                                     | :                                             | NIL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Contact hours/week</b>                                                                                                                                                                                                                                                                                                                                                                                                                                        | :                                             | Lecture :3, Tutorial :1, Practical: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Number of Credits</b>                                                                                                                                                                                                                                                                                                                                                                                                                                         | :                                             | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Course Assessment methods</b>                                                                                                                                                                                                                                                                                                                                                                                                                                 | :                                             | Continuous assessment through tutorials, attendance, home assignments, quizzes and one Minor test and One Major Theory Examination                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Course Objectives</b>                                                                                                                                                                                                                                                                                                                                                                                                                                         | :                                             | This course aims at the following educational objectives: To plan Bar Chart, CPM chart, PERT chart material requirement schedule, Manpower schedule, Machinery Schedule, Construction Management. to analyze, evaluate and design construction contract documents.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Course Outcomes</b>                                                                                                                                                                                                                                                                                                                                                                                                                                           | :                                             | The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course <ol style="list-style-type: none"> <li>1. Understand the use of advanced materials in construction projects</li> <li>2. Plan and develop management solutions to construction projects.</li> <li>3. Evaluate construction project economics, cost-benefit analysis and breakeven analysis.</li> <li>4. Understand the principles of project management, resource management and inventory</li> <li>5. Understand the different types of contracts in construction arbitration and legal aspects and its provision</li> <li>6. Analyse the different aspects of the contracts and their legal provisions.</li> </ol> |
| <b>Topics Covered</b>                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>UNIT I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                               | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Neo Construction Materials Special Concretes: High strength concrete, Effect of RHA on the properties of HSC, High performance concrete –applications, Self-Compacting Concrete, Concrete made with waste rubber, Special Concretes, Sulfur Concrete, Ferro cement, Geo synthetics, Nano Concrete, Changes in concrete with respect to time                                                                                                                      |                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>UNIT II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                               | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Elements of Management: Project cycle, Organisation, planning, scheduling monitoring updating and management system in construction. Network Techniques: Bar charts, milestone charts, work break down structure and preparation of networks. Application of network Techniques like PERT, GERT, CPM AON and AOA in construction management. Project monitoring, cost planning, resource allocation through network techniques. Line of balance technique.       |                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>UNIT III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                               | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Engineering Economics: Time value of money, Present economy studies, Equivalence concept, financing of projects, economic comparison present worth method Equivalent annual cost method, discounted cash flow method, analytical criteria for postponing of investment retirement and replacement of asset. Depreciation and break even cost analysis.                                                                                                           |                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>UNIT IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                               | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Contract Management: Legal aspects of contraction, laws related to contracts, land acquisition, labour safety and welfare. Different types of contracts, their relative advantages and disadvantages. Elements of tender preparation, process of tendering pre-qualification of contracts, Evaluation of tenders, contract negotiation and award of work, monitoring of contract extra items, settlements of disputes, arbitration and commissioning of project. |                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

**Textbooks**

1. Engineering Drawing-Bhat, N.D.& M. Panchal, Charotar Publishing House, 2008

**Reference books**

1. Callahan, M. T., Quackenbush, D. G., and Rowings, J. E., Construction Project Scheduling, McGraw-Hill, New York, 1992.

2. Cleland, D. I. and Ireland, L. R., Project Management: Strategic Design and Implementation 4th Edition, McGraw-Hill, New York, 2002.

3. Danny Myers, Construction Economics: A New Approach, Taylor and Francis Publisher, 2004.

4. Harold Kerzner Project Management CBS Publisers & Distributors 2nd Edition

5. Kumar Neeraj Jha, Construction Project Management, Pearson Publication

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|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| BCE 353                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |   | WATER RESOURCES ENGINEERING                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |
| Course category                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | : | Professional Core (PC)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |  |
| Pre-requisite Subject                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | : | NIL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |  |
| Contact hours/week                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | : | Lecture : 3, Tutorial : 1 , Practical: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |
| Number of Credits                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | : | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |
| Course Assessment methods                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | : | Continuous assessment through tutorials, attendance, home assignments, quizzes, viva voce, One Minor Test, and One Major Theory Examination                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |
| Course Objective                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | : | To understand and learn about different hydrological processes and design of unlined canals.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |  |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | : | The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course<br>1. Design of water management systems utilizing the basic principles of the hydrologic cycle.<br>2. Apply knowledge for efficient design methods for rapid conveyance of water with lesser loss in irrigation canals.<br>3. To demonstrate a knowledge of the multi-disciplinary nature of water resources engineering.<br>4. Realize the importance of optimal water use for growing the crops, and apply methods for saving land from water-logging.<br>5. To demonstrate technique involved in making design problems of canal and related structures to be safe and cost-effective.<br>6. Apply the knowledge in the design of hydraulic structures to be constructed for conveyance of irrigation water. |  |
| Topics Covered                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  |
| UNIT I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |   | 9                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |
| Introduction– Irrigation, water resources of India, need of irrigation in India, development of irrigation in India, impact of irrigation on human environment, irrigation systems: minor and major irrigation projects, command area development. Hydrology– hydrologic cycle, rainfall-runoff process, factors affecting runoff, runoff hydrograph, runoff computations, flood discharge calculations for ungauged and gauged sites, unit hydrograph method, S -hydrograph, different methods of flood forecasting. |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  |
| UNIT II                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |   | 9                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |

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|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| <b>Water requirement of crops:</b> Crops and crop seasons in India, cropping pattern; Quality of irrigation water; Soil-water relationships- soil characteristics significant from irrigation considerations, root- zone soil water, infiltration, consumptive use, irrigation requirement, frequency of irrigation; duty and delta. Methods of applying water to the fields: surface, sub-surface, sprinkler, and trickle/drip irrigation types and its design and drawing.                                                                                                                                                                                                                                                                                                                                                                |          |
| <b>UNIT III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>9</b> |
| <b>Irrigation channels:</b> Sediment threshold and method of calculation, and design of lined and unlined channels. Silt Theories: Kennedy's, Lacey's, Tractive force Ackers and White and Engelund & Hansen method; Design procedure for irrigation channels, Longitudinal cross section, Schedule of area statistics and channel dimensions, use of Garret's Diagrams in channel design, cross sections of an Irrigation channel, Computer programs for design of channels, Lining of Irrigation Canals: Advantages and types, factors for selection of a particular type, design of lined channels, cross section of lined channels, Economics of canal lining.<br>Water- logging: Definition, effects, causes and anti-water logging measures, Drainage of water-loggedland, Types of drains open and closed, spacing of closed drains. |          |
| <b>UNIT IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>9</b> |
| <b>Irrigation Outlets:</b> Requirements, types, non-modular, semi-module and rigid module, selection criterion. River Training: Objective and need, classification of rivers, and river training works, Lane Weight Balance Theory, meandering, stages, different methods of river training, design and drawing with field example problem as per IS code and IRC, bank protection, Methods for measurement of discharge.                                                                                                                                                                                                                                                                                                                                                                                                                   |          |
| <b>Textbooks</b> <ol style="list-style-type: none"> <li>1. Irrigation Engg. and Hydraulic Structures -.K. Garg, Khanna Publishers.</li> <li>2. Irrigation and water Power engineering - B.C. Punmia, Laxmi Publications.</li> <li>3. Engineering Hydrology - K. Subramanya, TMH.</li> <li>4. Irrigation Water Power and Water Resource Engg. - K.R. Arora.</li> </ol> <b>Reference Books</b> <ol style="list-style-type: none"> <li>1. Water Resources Engg. - Larry W. Mays, John Wiley India.</li> <li>2. Water resources Engg. - Wurbs and James, John Wiley India.</li> <li>3. Water Resources Engg. - R. K. Linsley, McGraw Hill.</li> <li>4. Irrigation and water Resources Engg. - G L Asawa, New age International Publishers.</li> <li>5. Irrigation Theory and practices - A.M. Michel.</li> </ol>                                |          |

| <b>BCE 354</b>                   |   | <b>ADVANCED SURVEYING</b>                                                                                                                                                                                                                                                                                                                                                                                  |
|----------------------------------|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course category</b>           | : | Professional Core (PC)                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Pre-requisite Subject</b>     | : | Basic surveying (BCE 213)                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Contact hours/week</b>        | : | Lecture: 3, Tutorial:0, Practical:2                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Number of Credits</b>         | : | 4                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Course Assessment methods</b> | : | Continuous assessment through attendance, home assignments, quizzes, practical work, record, viva voce and One Minor Test and One Major Theory & Practical Examination                                                                                                                                                                                                                                     |
| <b>Course Objectives</b>         | : | The main objectives of the course are: <ol style="list-style-type: none"> <li>1. To make students aware with different advance surveying methodologies applied to carry out large scale survey works using modern techniques such as total stations, photogrammetry remote sensing etc.</li> <li>2. To make students able to set out curves, buildings, and culverts for construction projects.</li> </ol> |

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|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course Outcomes</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | : | <p>The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course</p> <ol style="list-style-type: none"> <li>1. To understand the method of triangulation and the concept of photogrammetry and photo interpretation</li> <li>2. To learn on the principles of Electronic distance measurements, Total station and their accuracy</li> <li>3. To analyse the precision and accuracy of observations and least square adjustment of triangle and quadrilateral without central station.</li> <li>4. To compute and set different types of curves.</li> <li>5. To be aware of modern advanced surveying techniques such as Remote sensing, GPS and GIS</li> <li>6. Students learn to work with others, respect the contributions of others, resolve difficulties, and understand responsibility</li> </ol> |
| <b>Topics Covered</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>UNIT I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <p>Triangulation, different networks, orders and accuracies, inter visibility and height of stations, signals and towers, Baseline measurement, instruments and accessories, extension of baseline, satellite stations, Reduction to centre. Method of observation equations – conditioned quantities, method of correlates, adjustment of simple triangle and quadrilateral network without central station. Principle of Electronic Distance Measurement, Modulation, Types of EDM instruments, Distomat, Total Station – Parts of a Total Station – Accessories – Advantages and Applications, Field Procedure for total station survey, Errors in Total Station Survey; Trilateration.</p> |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>UNIT-II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <p>Curve setting – Horizontal curves - Elements and Methods of setting out simple, compound and Reverse curves, Transition curve (true spiral, cubic spiral and cubic parabola), Vertical curve (parabola). Setting out of buildings – culverts – tunnels</p>                                                                                                                                                                                                                                                                                                                                                                                                                                  |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>UNIT III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <p>Photogrammetry – Terrestrial and Aerial Photogrammetry, Geometry and scale of vertical photographs, relief and tilt displacement, Stereoscopy and elevation of a point – Flight Planning for vertical photographs– Planimetric mapping from vertical photos — Fundamentals of aerial photo interpretation, mosaics, map substitutes.</p>                                                                                                                                                                                                                                                                                                                                                    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>UNIT IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <p>Global Positioning Systems- Segments, GPS measurements, errors and biases, Surveying with GPS, Co-ordinate transformation, accuracy considerations. Remote Sensing- Introduction – Remote sensing concepts, Electromagnetic Spectrum, interaction of electromagnetic radiation with the atmosphere and earth surface, remote sensing data acquisition: platforms and sensors; visual image interpretation; digital image processing. Geographic Information System- Basic concepts of geographic data, GIS and its components, Data models, Topology, Process in GIS: Data capture, data sources, data encoding, geospatial analysis, GIS Applications</p>                                  |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <p><b>Experiments</b></p> <ol style="list-style-type: none"> <li>1. Demonstration and working on Total Station</li> <li>2. To layout a precise traverse in a given area and to compute the adjusted coordinates of survey stations</li> <li>3. Aerial Photo interpretation</li> <li>4. Demonstration and working with Mirror stereoscopes, Parallax bar and Aerial photographs.</li> <li>5. Visual Interpretation using false colour composite</li> <li>6. Demonstration and practice work with handheld GPS</li> </ol>                                                                                                                                                                        |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

**Textbooks**

1. K.R. Arora, "Surveying", Vol. I & II Standard Book House, Delhi,
2. B.C Punmia, "Surveying", Vol. I, II & III Laxmi Publications New Delhi,
3. S.K. Duggal., Surveying Vol. I & II Tata McGraw Hill
4. A.M. Chandra., "Plane Surveying", New Age International Publishers, Delhi
5. R. Subramanian Surveying and Levelling Oxford University Press

**Reference books**

1. W. Schofield Engineering Surveying Elsevier
2. Charles D Ghilani and Paul R Wolf Elementary Surveying Pearson

| BHS 301/351                      |  | ENGINEERING AND MANAGERIAL ECONOMICS |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|----------------------------------|--|--------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course category</b>           |  | :                                    | HSSE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Pre-requisite Subject</b>     |  | :                                    | NIL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Contact hours/week</b>        |  | :                                    | Lecture:3, Tutorial:1, Practical:0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Number of Credits</b>         |  | :                                    | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Course Assessment methods</b> |  | :                                    | Continuous assessment through One test, teacher's assessment (quiz, tutorial. assignment, attendance), and One Major Theory Examination.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Course Objectives</b>         |  | :                                    | <ol style="list-style-type: none"> <li>1. To make fundamentally strong base for decision making skills by applying the concepts of economics.</li> <li>2. Educate the students on how to systematically evaluate the various cost elements of a typical manufactured product or service, with a view to determining the price offer.</li> <li>3. Prepare engineering students to analyze profit/revenue data and carry out make economic analysis in the decision-making process to justify or reject alternatives/projects.</li> <li>4. Be equipped with the tools necessary in forecasting product demand.</li> <li>5. Understand and analyze the macro environment affecting the business decision making.</li> <li>6. To make students understand basic elements of Indian Economy.</li> </ol>                                                                                                                                                            |
| <b>Course Outcomes</b>           |  | :                                    | <p>The students will be able to demonstrate the following knowledge, skills, and attitudes upon completion of the course: -</p> <ol style="list-style-type: none"> <li>1. Students will acquire basic knowledge in Engineering &amp; managerial economics, which allows students to gain theoretical and empirical skill of economics.</li> <li>2. To make Engineering students prepared for economic empowerment so that they could manage their wealth, help them in starting their own business or during managerial period.</li> <li>3. Students will develop Interdisciplinary skills which can help them to thrive in the life- long changing environment in various fields of Industry of Economics.</li> <li>4. Students will acquire practical knowledge of economics, the kind of markets, cost theory, various issues of demand and other major economic concepts.</li> <li>5. Able to explain succinctly the meaning and definition of</li> </ol> |

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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  | <p>managerial economics; elucidate on the characteristics and scope of managerial economics.</p> <p>6. Able to describe the techniques of managerial economics.</p> <p>7. Able to explain the applications of managerial economics in various aspects.</p> <p>8. To learn about the management and economics of the industrial environment.</p> |
| <b>Topics Covered</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  |                                                                                                                                                                                                                                                                                                                                                 |
| <b>UNIT I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  | 9                                                                                                                                                                                                                                                                                                                                               |
| Introduction to the Managerial Economics- Economics and Managerial economics, Review of Economic Terms and Economic Rationality, Law of diminishing marginal utility, Theories of Profit, Decision making Process with reference to Managerial economics, Managerial Economics and its application in engineering perspective.                                                                                                                                                                                       |  |                                                                                                                                                                                                                                                                                                                                                 |
| <b>UNIT II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |  | 9                                                                                                                                                                                                                                                                                                                                               |
| <b>Theory of Demand:</b> Law of Demand, Demand Function, Types of Demand, Demand Schedule, Demand Curve, Shift in Demand Curve, Factors affecting Demand, Elasticity of Demand, Theory of consumer behavior. <b>Theory of Supply:</b> Law of Supply, Supply Function, Supply Schedule, Supply Curve, Factors, affecting Supply                                                                                                                                                                                       |  |                                                                                                                                                                                                                                                                                                                                                 |
| <b>UNIT III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  | 9                                                                                                                                                                                                                                                                                                                                               |
| Demand Forecasting: Meaning, significance and methods of demand forecasting, production function, Laws of returns to scale & Law of Diminishing returns scale. An overview of Short and Long run cost curves – fixed cost, variable cost, average cost, marginal cost, Opportunity cost.                                                                                                                                                                                                                             |  |                                                                                                                                                                                                                                                                                                                                                 |
| <b>UNIT IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |  | 9                                                                                                                                                                                                                                                                                                                                               |
| Market Structure: Perfect Competition, Imperfect competition – Monopolistic, Oligopoly, duopoly<br>salient features of price determination and various market conditions. National Income, Inflation and Business Cycles: Concept of N.I. and Measurement. Meaning of Inflation, Type causes & prevention methods, Phases of business cycle                                                                                                                                                                          |  |                                                                                                                                                                                                                                                                                                                                                 |
| <b>Textbooks</b> <ol style="list-style-type: none"> <li>1. Mote, Paul and Gupta, Managerial Economics, T M H, New Delhi.</li> <li>2. H L Ahuja, Managerial Economics, S Chand &amp; Co. New Delhi</li> <li>3. P.L. Mehta, Managerial Economics, Analysis, Problems and Cases, Sultan Chand Sons, New Delhi.</li> <li>4. Prof. D.N. Kakkar , Managerial Economics for Engineering, PHI publication, New Delhi</li> <li>5. Varshney and Maheshwari, Managerial Economics, Sultan Chand and Sons, New Delhi.</li> </ol> |  |                                                                                                                                                                                                                                                                                                                                                 |

### BMS-301/351

**Course category**

**Pre-requisite Subject**

**Contact hours/week**

**Number of Credits**

**Course Assessment methods**

**Course Objectives**

**Course Outcomes**

### Principles of Industrial Management

: Management (M)

: NIL

: Lecture: 3, Tutorial: 1, Practical: 0

: 4

: Continuous assessment through tutorials, attendance, home assignments, quizzes and one Minor Test and one Major Theory Examination.

To enable students to develop operational skills and analyzing different situations in the industrial scenario having limited resources and obtain the optimal solution with and without constraints.

: The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course



1. Students should be able to become efficient and acquire acumen for more profitable business practices.
2. Students should be able to understand the importance of better customer service and product quality.
3. Students should be able to make work safer, faster, easier, and more rewarding.
4. Students should be able to help the industry in the production of more products that possess all utility factors
5. Students should be able to reduce costs associated with new technologies.
6. Students should be able to understand different principle of Industrial Management.

### **Topics Covered**

#### **UNIT-I**

**Introduction of Industrial Management:** Definition, Nature and Scope of Management, Process of management, Elements of management, Definition of industrial management, Scope and Application of industrial management.

**Plant Location and Layout:** Factors affecting Plant Location, Objectives and Principles of Plant Layout, Types of Plant-Layout

#### **UNIT-II**

**Work Analysis and Measurement:** Design of work study, steps involved in work-study process, Definition and Concept of Method study, Procedure involved in Method study, Objectives and techniques of Work Measurement, worksampling and its application, Selection of Personnel and wage payment plans.

#### **UNIT-III**

**Material Management:** Meaning of Inventory management, Economic Order Quantity Model, ABC analysis, Just-in-time, Minimum Safety Stock

**Industrial Safety:** Occupational safety, safety programs; Safety aspects in work system design

#### **UNIT-IV**

**Project Management:** Meaning, Features, Project management life cycle, Project cost control System, Project planning and control, Project scheduling and techniques.

#### **Text & Reference books:**

1. Joseph Russell Smith, "The Elements of Industrial Management", Hard Press
2. Gavriel Salvendy, "Handbook of Industrial Engineering: Technology and Operations Management", John Wiley & Sons, Inc.
3. S. N. Chary, "Production and Operations Management", Tata McGraw Hill
4. R. Paneerselvam, "Production and Operations Management", PHI
5. E. S. Buffa and R. K. Sarin, Modern Production/ Operations Management, Wiley.

### Syllabus For PE1 and PE2 Elective Subjects

|                                                                                                                                                                   |                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>ECE 101</b>                                                                                                                                                    | <b>Matrix Method of Analysis</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Course category</b>                                                                                                                                            | :                                | Professional Elective-1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Pre-requisite Subject</b>                                                                                                                                      | :                                | NIL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Contact hours/week</b>                                                                                                                                         | :                                | Lecture: 3, Tutorial: 1, Practical: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Number of Credits</b>                                                                                                                                          | :                                | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Course Assessment methods</b>                                                                                                                                  | :                                | Continuous assessment through tutorials, attendance, home assignments, quizzes, record, One Minor tests and One Major Theory Examination.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Course Objectives</b>                                                                                                                                          | :                                | The main objective is to expand the student knowledge of the stiffness and flexibility methods studied in the basic structural analysis courses. This course is also expected to enable a good understanding of how standard software packages and students will be able to implement the method developing their own computer program to analyze structures.                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Course Outcomes</b>                                                                                                                                            | :                                | <p>The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course</p> <ol style="list-style-type: none"> <li>1. To understand the basic concepts of structural analysis and matrix algebra.</li> <li>2. To understand the matrix methods can be applied to plane and space trusses; beams and grids; plane and spaceframes.</li> <li>3. To identify a suitable system of releases (flexibility method) or an appropriate set of degrees of freedom (stiffness method).</li> <li>4. To formulate and solve the equilibrium equations (stiffness method) or boundary conditions (flexibility method).</li> <li>5. Ability to use modern structural analysis software.</li> <li>6. Able to understand and analysis complex structures.</li> </ol> |
| <b>Topics Covered</b>                                                                                                                                             |                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>UNIT-I</b>                                                                                                                                                     |                                  | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Introduction to Flexibility and stiffness method. Hand computation of problems on beam.                                                                           |                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>UNIT-II</b>                                                                                                                                                    |                                  | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Hand computation of problems on trusses, frames and grids.                                                                                                        |                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>UNIT III</b>                                                                                                                                                   |                                  | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Generalized computer-oriented treatment of stiffness method, Method of assembling the stiffness matrix, substructure technique for solving very large structures. |                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>UNIT IV</b>                                                                                                                                                    |                                  | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Analysis for imposed deformation, temperature, support settlement, etc. Transfer matrix method of analyzing framed structure.                                     |                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Textbooks</b>                                                                                                                                                  |                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 1.H.C. Matrix, Introduction to Matrix Methods, of structural Analysis, McGraw Hill, New York.                                                                     |                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Reference books</b>                                                                                                                                            |                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 1.Weaver & Gere, Matrix Analysis of Framed structures.                                                                                                            |                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

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| <b>ECE 102</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>GEOTECHNICAL INVESTIGATIONS AND FIELD TESTING OF SOIL</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Course category</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Professional Elective - 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Pre-requisite Subject</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | NIL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Contact hours/week</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Lecture: 3, Tutorial : 1 , Practical: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Number of Credits</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Course Assessment methods</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Continuous assessment through attendance, home assignments, quizzes, practical work, record, viva voce and One Minor test and One Major Theory Examination                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Course Objectives</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <p>The objectives of the course are as follows:</p> <ol style="list-style-type: none"> <li>1. To Understand the types of soil and develop various applications of soil as a construction material for civil engineering structures.</li> <li>2. To Evaluate the soil quality to understand the basic relationships between physical and mechanical properties of soils.</li> <li>3. To understand the soil testing methods as the basic knowledge of classification and engineering properties of soil</li> <li>4. To understand the different ground modification methods and the experimental methods for laboratory as well as field investigations.</li> </ol> |
| <b>Course Outcomes</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <p>After completion of this course the students to demonstrate following knowledge, skills and attitudes.</p> <ol style="list-style-type: none"> <li>1. Comprehend the basics of site investigation methods and field tests and its extent for variety of structures including preliminary investigations.</li> <li>2. Identify and suitable investigation method for soil exploration.</li> <li>3. Illustrate different specialized exploration methods based on condition and requirement.</li> <li>4. Appraise different codal provisions for field tests</li> <li>5. Basic knowledge about soil explorations and field investigations.</li> </ol>              |
| <b>Topics Covered</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>UNIT-I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Soil Formation, types of soils, physical and biological weathering, soil transport, deposition and stratification phenomena and Soil Classification. Clay minerals; coarse-grained and fine-grained soil for engineering use. Interpretations And Codal Provisions: Soil profiling, interpretation of exploration data and report preparation, various standards for soil investigations. Purpose and Phases of Soil Investigation.                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>UNIT-II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Exploration Methods: Methods of Boring, Augering and Drilling. Machinery used for drilling, types of augers and their usage for various projects. Soil Sampling: sampling methods, types of samples, storage of samples and their transport. Sample preparation, sample sizes, types of samplers specifications for soil testing. Trial pits, disturbed and undisturbed sampling Detailed bore hole investigations: types of borings and types of samplers. Compaction: Standard and Modified Proctor compaction tests; field compaction; compaction quality control: Proctor Needle Test, |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>UNIT III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Field testing of soils: methods and specifications – visual identification tests, vane shear test, penetration tests, analysis of test results. Report writing: Soil exploration Reports- identification, calculations and preparation. Field Instrumentation: Rollers, Pressure meters, Piezometer, Pressure cells, Sensors, Inclinoimeters, Strain gauges etc, Collection of geological data, Resistivity and Seismic Refraction methods.                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>UNIT IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Field Tests: Plate load test, pile load test, SPT test, CPT test, flat dilatometer test, DCPT test, Vane shear test, pressure meter test, field CBR test, core cutter, sand replacement test, nuclear probe method, block shear test. Introduction to Ground Modification: Need and objectives of Ground Improvement, Classification of Ground                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

Modification Techniques – suitability and feasibility, Emerging Trends in ground improvement.

**Textbooks**

- Alam Singh – Modern Geotechnical Engineering, Asia Publishing House, New Delhi.
- Gopal Ranjan and A.S.R. Rao – Basic and Applied Soil Mechanics, New Age International (P) Ltd.
- B.C. Punamia – Soil Mechanics and Foundations, Laxmi Publications (P) Ltd.
- C. Venkataramaiah – Geotechnical Engineering, New Age International (P) Ltd., New Delhi.

**Reference Books**

- Schnaid, F. (2009) In Situ Testing in Geomechanics : The Main Tests. Taylor & Francis.
- J. E. Bowles, “Foundation Analysis and Design”, McGraw Hill Companies, 1997.
- M. D., Desai, “Ground Property Characterization from In-Situ Testing”, Published by IGS-Surat Chapter, 2005.
- M. J., Hvorslev, “Sub-Surface Exploration and Sampling of Soils for Civil Engineering Purposes”, US Waterways Experiment Station, Vicksburg, 1949.
- Robert M. Koerner “Construction and Geotechnical methods in Foundation Engineering”, Mc.Graw-Hill Pub. Co., New York, 1985.
- Manfred R. Haussmann, “Engineering principles of ground modification”, Pearson Education Inc. New Delhi, 2008.
- F. G., Bell, “Engineering Treatment of Soils”, E& FN Spon, New York, 2006.
- P. Purushothama Raj, “Ground Improvement Techniques” Laxmi Publications (P) Limited, 2006.
- Jie Han et. al., “Advances in ground Improvement” Allied Pub., 2009.
- Hunt Roy E , Geotechnical Investigation Methods, A Field Guide for Geotechnical Engineers, Taylor & Francis Ltd.

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| <b>ECE 103</b>                   |   | <b>GLOBAL WARMING AND CLIMATE CHANGE</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |
| <b>Course category</b>           | : | Professional Elective - 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |
| <b>Pre-requisite Subject</b>     | : | NIL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |  |
| <b>Contact hours/week</b>        | : | Lecture: 3, Tutorial:1, Practical: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |  |
| <b>Number of credits</b>         |   | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |  |
| <b>Course Assessment methods</b> | : | Continuous assessment through tutorials, attendance, home assignments, quizzes, record, two Minor tests and One Major Theory Examination.                                                                                                                                                                                                                                                                                                                                                                                     |  |
| <b>Course Objectives</b>         | : | The main objective is to expand the student knowledge of the climate change, its causes, impacts, and global responses such as the Kyoto Protocol and Clean Development Mechanisms.                                                                                                                                                                                                                                                                                                                                           |  |
| <b>Course Outcomes</b>           | : | The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course<br>1. To make the students understand about the sources of energy<br>2. To understand about the effects of greenhouse gases.<br>3. To have adequate knowledge on impacts of climate change.<br>4. To acquire knowledge on modelling on climate change.<br>5. To have adequate knowledge on carbon credit.<br>6. To understand rules and protocols on global trading related to global warming. |  |
| <b>Topics Covered</b>            |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |
| <b>UNIT-I</b>                    |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |

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| Energy Sources: Global Warming Potential, Energy Issues and Climate Change, Alternate Energy Sources. Greenhouse Effect: Green house as natural phenomenon, Greenhouse Gases (GHGs) and their Emission, Sources. Quantification of CO <sub>2</sub> Emission, Global Warming Potential of GHGs.                                                       |          |
| <b>UNIT-II</b>                                                                                                                                                                                                                                                                                                                                       | <b>9</b> |
| Impacts of Climate Change: Effects on climatic and related changes, Global and Indian, scenario. Temperature Rise. Sea Level rise, Coastal Erosion and landslides, Coastal Flooding. Wetlands and Estuaries loss. Modelling on Climate Change: Case studies on climate change, Data analysis, Interpretation, Ozone layer depletion and its control. |          |
| <b>UNIT-III</b>                                                                                                                                                                                                                                                                                                                                      | <b>9</b> |
| Kyoto Protocol: Importance. Significance and its role in Climate Change. Carbon Credit and Trading: Mechanisms, Various Models Global and Indian Scenario.                                                                                                                                                                                           |          |
| <b>UNIT-IV</b>                                                                                                                                                                                                                                                                                                                                       | <b>9</b> |
| Cleaner Development Mechanisms: Various Projects related to CO <sub>2</sub> Emission Reduction. Alternatives of Carbon Sequestration - Conventional and non-conventional techniques, Role of Countries and Citizens in Containing Global Warming.                                                                                                    |          |
| <b>Textbooks</b><br>1. Francis D., (2000), "Global Warming: The Science and Climate Change", 1st Edition, Oxford University Press.                                                                                                                                                                                                                   |          |
| <b>Reference books</b><br>1. Barry R.G., and Chorley R.L., (2017), "Atmosphere, Weather and Climate", 4th Edition, ELBS Publication.<br>2. Bolin B., (Ed.), (1981), "Carbon Cycle Modelling, John Wiley and Sons Publications.<br>3. Corell R.W., and Andenon P.A., (Eds). (1991), "Global Environmental Change", Springer Vetlog Publishers.        |          |

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| <b>ECE 104</b>                   | <b>PRINCIPLE OF HIGHWAY ENGINEERING</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Course category</b>           | Professional Elective - 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Pre-requisite subject</b>     | NIL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Contact hours/week</b>        | Lecture: 3; Tutorial: 1; Practical: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>No. of credits</b>            | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Course assessment methods</b> | Continuous assessment through tutorials, attendance home assignments, : quizzes, practical work, record, viva voce and one Minor tests and One Major Theory                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Course Objective</b>          | Followings are the course objectives of this course: <ol style="list-style-type: none"> <li>1. To introduce the fundamental principles and scope of highway and transportation engineering</li> <li>2. To develop skills for planning and conducting highway alignment surveys and preparing related documentation.</li> <li>3. To familiarize with the various materials used in highway construction</li> <li>4. To enable application of economic evaluation methods for assessing highway projects and making informed decisions.</li> </ol> |

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|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course outcomes</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <p>The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course:</p> <ol style="list-style-type: none"> <li>1. Understand the fundamental concepts and scope of highway and transportation engineering.</li> <li>2. Aware basic road classification and the road authorities in india</li> <li>3. Plan and carry out highway alignment surveys</li> <li>4. Identify different types of Materials used in highway construction</li> <li>5. Perform and interpret basic laboratory tests on highway materials to assess their suitability for pavement construction.</li> <li>6. Evaluate highway projects using economic analysis methods</li> </ol> |
| <b>Topic covered</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>UNIT-I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Highway Introduction, Scope, Planning & Development Highway planning in India, Development, Rural and urban roads, Road departments in India, Road classification, Road authorities i.e. IRC, CRRI, NHAI, NHDP etc                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>UNIT-II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Highway Alignment & Surveys: Reconnaissance, Aerial surveys, Location surveys, Location of bridges, Problems in rural and urban areas. Highway drawings & reports Highway project preparation                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>UNIT-III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Highway Materials and construction Aggregates and their types, physical and engineering properties, Fillers, Bitumen, Characteristics, Emulsions and cutbacks, Basic tests on all materials: construction of flexible and rigid pavement.                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>UNIT-IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Highway Economics & Finance Financing of road projects, administration of roads, PPP models, Road safety audit, Methods of economic evaluation of highway projects                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Text Books/Reference books:</b> <ol style="list-style-type: none"> <li>1. Khanna, S. K. and Justo, C. e. G., Manual for Highway testing manuals, Enchant Bros., Roorkee.</li> <li>2. Das A and Chakraborty P, Principles of Transportation Engineering, PHI Pvt. Ltd. New Delhi</li> <li>3. Kadiyali, L.R. &amp; Lal, N.B., Principles &amp; Practices of Highway Engineering, Khanna Publishers, New Delhi.</li> <li>4. Wright, P. H., Highway Engineering, John Wiley and Sons, New York</li> <li>5. Indian standards, ASTM Codes, IRC codes, MoRTH Specifications</li> </ol> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

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| <b>ECE 105</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>ENGINEERING HYDROLOGY</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Course Category</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Professional Elective 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Contact hours/week</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Lecture – 3; Tutorial – 1; Practical – 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Number of credits</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Course assessment methods</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Continuous assessment through attendance, home assignments, quizzes, two minor practical exam and One Major Practical Examination                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Course Objectives</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <ol style="list-style-type: none"> <li>1. To study occurrence movement and distribution of water that is a prime resource for development of a civilization.</li> <li>2. To know diverse methods of collecting the hydrological information, which is essential, to understand surface and ground water hydrology.</li> <li>3. To know the basic principles of streamflow measurement</li> <li>4. To understand the principles of watershed management and flood routing</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Course Outcomes</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <p>The students are expected to be able to demonstrate the following knowledge, skills, and abilities after completing this course:</p> <ol style="list-style-type: none"> <li>1. A background in the theory of hydrological processes and their measurement</li> <li>2. Apply science and engineering fundamentals to solve current problems and to anticipate, mitigate and prevent future problems in water resources management</li> <li>3. An ability to manipulate hydrological data and undertake widely used data analysis.</li> <li>4. A systematic understanding of the nature of hydrological stores and fluxes and a critical awareness of the methods used to measure, analyse and forecast their variability; and the appropriate contexts for their application.</li> <li>5. An understanding in principles of watershed management</li> </ol> <p>An ability to apply momentum, energy and mass balance equations for routing flood through rivers and reservoirs</p> |
| <b>Topics Covered</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Unit – I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Introduction:</b> Hydrologic cycle, processes and budget; Fundamentals of hydrometeorology, Indian monsoon system<br><b>Frequency Analysis:</b> Random variables, Probability distribution functions: normal, log-normal, Gumbel, Pearson type-3 uniform distributions; Frequency analysis; Goodness of fit measures.                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Unit – II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Precipitation Measurement and Analysis:</b> Precipitation variability, rainfall and snow measurement techniques, design of precipitation gauging network, consistency of rain record, filling up of missing record, estimation of mean areal rainfall, IDF and DAD analysis, Snow measurement and estimation of snow melt.<br><b>Hydrologic Abstractions:</b> Interception and depression storage; Evaporation: factors affecting, measurement and estimation; Evapotranspiration: measurement and estimation; Infiltration, factors affecting infiltration, measurement of infiltration, empirical and analytical models of infiltration; Rain harvesting: procedures and design. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Unit – III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Stream Flow:</b> Runoff process: measurement of stream flow, factors affecting stream flow; Stage- discharge relationship; Peak discharge estimation; hydrograph analysis, base flow separation, unit hydrograph for stream flow estimation, synthetic unit hydrograph, hydrological modeling                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Unit – IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Watershed Management:</b> Watershed and its characteristics; Curve number method; Soil erosion and estimates; Watershed management techniques, Erosion control.<br><b>Flood Routing:</b> Governing equations, Reservoir flood routing, Hydrologic routing: Muskingum method.                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

**Textbooks**

1. Chow, V.T., Maidment, D.R. and Mays, L.W.: Applied Hydrology, Mc Graw Hill 1998
2. Mays, L.W.: Water resources Engineering, John Wiley and Sons 2001
3. Singh V.P., Elementary Hydrology, Prentice Hall of India 1994
4. Subramanya, K., Engineering Hydrology, 4th Edition, Tata Mc Graw Hill 2013
5. C.W. Fetter, Applied Hydrogeology, Fourth Edition, CBS Publishers and Distributors, New Delhi, 2001 2001
6. H.M. Raghunath, Hydrology: Principles, Analysis and Design, 2nd edition, New Age International Publishers.

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| ECE 106                                                                                                                                                                                                                                                                                                                                                                                                                                                          | GEOGRAPHIC INFORMATION SYSTEM |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |
| Course category                                                                                                                                                                                                                                                                                                                                                                                                                                                  | :                             | Professional Elective - 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |  |
| Pre-requisite Subject                                                                                                                                                                                                                                                                                                                                                                                                                                            | :                             | NIL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |
| Contact hours/week                                                                                                                                                                                                                                                                                                                                                                                                                                               | :                             | Lecture:3,Tutorial: 1, Practical:0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |  |
| Number of Credits                                                                                                                                                                                                                                                                                                                                                                                                                                                | :                             | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |  |
| Course Assessment methods                                                                                                                                                                                                                                                                                                                                                                                                                                        | :                             | Continuous assessment through tutorials, attendance, home assignments, quizzes, two Minor tests, and One Major Theory Examination                                                                                                                                                                                                                                                                                                                                                                                                                                                    |  |
| Course Objectives                                                                                                                                                                                                                                                                                                                                                                                                                                                | :                             | This course aspires to: Introduce basic concepts in GIS, provide exposure to basic tools and techniques in GIS software and Introduce applications of GIS in relevant areas of civil engineering.                                                                                                                                                                                                                                                                                                                                                                                    |  |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                                                                  | :                             | The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course<br>1. Define what GIS is and know different types of spatial and non spatial data<br>2. Understand the GIS and its Data models<br>3. Know what are the questions that GIS can answer<br>4. Differentiate between Raster and Vector Models<br>5. Create maps and overlay features/raster data for basic analyses<br>6. Understand the applications of GIS in the fields of environmental, geotechnical, transportation and water resources engineering |  |
| Topics Covered                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |
| UNIT-I                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                               | 9                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |  |
| Definition of GIS, Cartography and GIS, GIS database: spatial and attribute data; Spatial models: Semantics, spatial information, temporal information, conceptual models of spatial information, Computer representation of geographic information: Regular tessellations, irregular tessellations, Vector representations, Topology and Spatial relationships, Scale and Resolution, Representation of Geographic fields, Representation of Geographic objects |                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |
| UNIT II                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                               | 9                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |  |



|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |          |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| <p>Raster and vector data input, raster to vector data conversion, map projection, analytical transformation, rubber sheet transformation, manual digitizing and semi-automatic line following digitizer; Remote sensing data as an input to GIS data</p> <p>Direct and indirect spatial data capture Accuracy and Precision, Positional accuracy, Attribute accuracy, temporal accuracy, Lineage, Completeness, Logical consistency</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |          |
| <b>UNIT III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>9</b> |
| <p>GIS database Concepts and management systems, Types of Database management Systems, hierarchical, network, relational models, Object oriented DBMS, GIS functionality; data storage and data retrieval through query, generalization, classification, containment search within a spatial region</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |          |
| <b>UNIT IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>9</b> |
| <p>Overlay: arithmetical, logical and conditional overlay, buffers, inter visibility, aggregation; Network analysis; Applications of GIS in planning and management of utility lines and in the field of environmental engineering, geotechnical engineering, transportation engineering and water resources engineering</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |          |
| <p><b>Textbooks</b></p> <ol style="list-style-type: none"> <li>1. Stan Arnoff Geographic Information Systems: A Management Perspective, WDL Publications.</li> <li>2. C.P. Lo and Albert K. W. Yeung, Concepts and Techniques of Geographical Information Systems, Prentice- Hall India</li> <li>3. Reddy, M. Anji, Remote sensing and Geographic Information System BS Publications Hyderabad</li> <li>4. B. Bhatta, Remote Sensing and GIS, Oxford University Press</li> </ol> <p><b>Reference Books</b></p> <ol style="list-style-type: none"> <li>1. Robert Laurini and Derek Thompson Fundamentals of Spatial Information Systems, Academic Press.</li> <li>2. Tor Bernhardsen Geographic Information Systems: An Introduction, Wiley</li> <li>3. Burrough P.A. and Rachel A. McDonell, Principles of Geographical Information Systems, Oxford Publication</li> <li>4. Michael N. DeMers, Fundamentals of Geographic Information Systems, Wiley</li> </ol> |          |

| <b>ECE 201</b>                   | <b>PRESTRESSED CONCRETE</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|----------------------------------|-----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course category</b>           | :                           | Professional Elective-2                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Pre-requisite Subject</b>     | :                           | NIL                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Contact hours/week</b>        | :                           | Lecture: 3, Tutorial: 1, Practical: 0                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Number of Credits</b>         | :                           | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Course Assessment methods</b> | :                           | Continuous assessment through tutorials, attendance, home assignments, quizzes and One Minor test/s and One Major Theory Examination                                                                                                                                                                                                                                                                                                                                     |
| <b>Course Objectives</b>         | :                           | <p>The course objectives are given below:</p> <ol style="list-style-type: none"> <li>1. Understand the concepts of pre-stressing in concrete structures and identify the materials for pre-stressing.</li> <li>2. Insight into the Pre-Tensioning and Post- Tensioning Processes to solve engineering problems.</li> <li>3. Techniques for construction for prestressed concrete.</li> <li>4. Design pre-tensioned and post tensioned girders for flexure and</li> </ol> |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |   | shear.<br>5. Design continuous pre-tensioned and post tensioned beams.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Course Outcomes</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | : | <p>The students are expected to demonstrate the following knowledge, skills and attitudes after completing this course.</p> <ol style="list-style-type: none"> <li>1. To learn the principles, materials, methods and systems of prestressing.</li> <li>2. To know the different types of losses and deflection of prestressed members.</li> <li>3. To learn the design of prestressed concrete beams for flexural, shear and tension and to calculate ultimate flexural strength of beam.</li> <li>4. To learn the design of anchorage zones, composite beams, analysis and design of continuous beam.</li> <li>5. Analyse a Pre-stressed Concrete section.</li> <li>6. Able to estimate the losses during the prestressing</li> </ol> |
| <b>Topics Covered</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>UNIT-I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Fundamentals of prestressing - Classification and types of prestressing Concrete Strength and strain characteristics<br>- Steel mechanical properties - Auxiliary Materials like duct formers. Prestressing Systems: Principles of pre- tensioning and post tensioning - study of common systems of prestressing for wires strands and bars.                                                                                                                                                                                                                                                                                                  |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>UNIT-II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Advantages of prestressing, methods of prestressing, Losses in prestress, analysis of simple prestressed rectangular and T-sections. Introduction to design of elements, load balancing concept, profile of cable.                                                                                                                                                                                                                                                                                                                                                                                                                            |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>UNIT-III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Analysis of Sections: In flexure, simple sections in flexure, Design of rectangular, T, I beam under flexure and shear using IS 1343, kern distance - cable profile - limiting zones - composite sections cracking moment of rectangular sections.                                                                                                                                                                                                                                                                                                                                                                                            |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>UNIT-IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Design of Simply Supported Beams: Allowable stress as per I.S. 1343 - elastic design of rectangular and I-sections. Shear and Bond: Shear and bond in prestressed concrete beams - conventional design of shear reinforcement - Ultimate shear strength of a section - Prestress transfer in pretensioned beams-Principles of end block design.                                                                                                                                                                                                                                                                                               |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Textbooks</b> <ol style="list-style-type: none"> <li>1. Krishna Raju. N., "Prestressed Concrete", Tata Mc Graw Hill., 6th Edition.</li> <li>2. Lin. T.Y, "Prestressed concrete", Wiley India, 2010.</li> </ol> <b>Reference Books</b> <ol style="list-style-type: none"> <li>1. Nawy, E. G., Prestressed concrete a fundamental approach 4th edition, Pearson Education, Inc. New Jersey, US., 2003.</li> <li>2. IS 1343:2012. Prestressed concrete - code of practice, Bureau of Indian Standards (BIS), New Delhi, India., 2012.</li> <li>3. Rajagopalan, "Prestressed concrete", Narosa Publishing House, 2017, 2nd Edition.</li> </ol> |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

|                              |                       |                         |
|------------------------------|-----------------------|-------------------------|
| <b>ECE 202</b>               | <b>ROCK MECHANICS</b> |                         |
| <b>Course category</b>       | :                     | Professional Elective-2 |
| <b>Pre-requisite Subject</b> | :                     | NIL                     |

|                                                                                                                                                                                                                                                                                                                                                                                                  |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Contact hours/week</b>                                                                                                                                                                                                                                                                                                                                                                        | : | Lecture: 3, Tutorial: 1, Practical: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Number of Credits</b>                                                                                                                                                                                                                                                                                                                                                                         | : | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Course Assessment methods</b>                                                                                                                                                                                                                                                                                                                                                                 | : | Continuous assessment through tutorials, attendance, home assignments, quizzes and One Minor test/s and One Major Theory Examination                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Course Objectives</b>                                                                                                                                                                                                                                                                                                                                                                         | : | <p>The course objectives are given below:</p> <ol style="list-style-type: none"> <li>1. Concepts of rock mass properties governed by deformation of rocks and development of discontinuity features.</li> <li>2. Insight to presence of in-situ and forced stresses in rock mass, their measurement will be able to solve engineering problems.</li> <li>3. Safe excavation techniques for construction of underground structures.</li> <li>4. Knowledge of Ground conditions in tunnelling with special reference to rock mass.</li> </ol>    |
| <b>Course Outcomes</b>                                                                                                                                                                                                                                                                                                                                                                           | : | <p>The students are expected to demonstrate the following knowledge, skills and attitudes after completing this course.</p> <ol style="list-style-type: none"> <li>1. Identification of the different types of rocks.</li> <li>2. Laboratory experiments to be done for the rock mass properties.</li> <li>3. Index properties of rock and rock mass.</li> <li>4. Determination of the strength of the rock by various failure criteria.</li> <li>5. Stress-strain behaviour of a rock mass.</li> <li>6. Foundations on weak rocks.</li> </ol> |
| <b>Topics Covered</b>                                                                                                                                                                                                                                                                                                                                                                            |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>UNIT-I</b>                                                                                                                                                                                                                                                                                                                                                                                    |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Rock Formation: rock forming minerals, identification, geological classification of rock, geological structures, faults, folds, joints. Laboratory Testing of Rocks for the determination of physical properties, uniaxial compressive strength, tensile strength, oblique shear stress. Triaxial test, slake durability test, stress-strain responses of rocks.                                 |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>UNIT-II</b>                                                                                                                                                                                                                                                                                                                                                                                   |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Engineering Classification of Rocks & Rock Masses: Deere and Miller classification, rock quality designation, rock mass rating, rock mass quality, geological strength index and their applications. Strength Criteria for Rocks & Rock Mass: Mohr-Coulomb criterion, Hoek and Brown criterion, Barton's theory.                                                                                 |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>UNIT-III</b>                                                                                                                                                                                                                                                                                                                                                                                  |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Tunneling: Ground conditions in tunneling, elastic analysis under uniaxial, biaxial and hydrostatic conditions, Concrete lining: elastic analysis, elasto-plastic analysis: Tresca criterion, rock mass-tunnel support interaction analysis, design of support system.                                                                                                                           |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>UNIT-IV</b>                                                                                                                                                                                                                                                                                                                                                                                   |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Rock Slope Stability Analysis: Modes of failure, limit equilibrium approaches, application of stereographic projections, remedial measures. Foundations of Weak Rocks: Bell's approach, bearing capacity based on classification approaches, UCS, plate load test, special considerations                                                                                                        |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Textbooks</b>                                                                                                                                                                                                                                                                                                                                                                                 |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <ol style="list-style-type: none"> <li>1. Ramamurthy.T, Engineering in Rocks for Slopes, Foundation and Tunnels, 2nd edition Prentice Hall India Pvt. Ltd.</li> <li>2. Goodman.R.E, Introduction to Rock Mechanics, John Wiley &amp; Sons.</li> </ol>                                                                                                                                            |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Reference Books</b>                                                                                                                                                                                                                                                                                                                                                                           |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <ol style="list-style-type: none"> <li>1. Verma B.P, Rock mechanics for engineers, Khanna Publishers, 2nd Edition 1989, New Delhi.</li> <li>2. David Chapman, Nicole Metje and Alfred Strak, "Introduction for Tunnel Construction", Applied geophysics Volume III, 1st Edition 2010.</li> <li>3. Jaeger Cook and Zimmerman, Fundamentals of Rock Mechanics, , 4th Edition, Blackwell</li> </ol> |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

Publishing, 2007. 4. Chandola. S.P, “A Textbook of Transportation Engineering”, S.Chand Publications, 1st 5. Edition, 2001.  
 5. Obert L and Wilbur I. Duvall, Rock mechanics and the design of structures in rock, John Wiley & Sons, Inc, 2003.  
 6. Bickel J.O., Kuesel T.R, and King E.H, “Tunnel Engineering Handbook”, Chapman & Hall/ITP Publishing Company, 1996, 544 pp.  
 7. Parker, A.D. “Planning and Estimating Underground Construction”, McGrawHill, 1970.

| <b>ECE 203</b>                                                                                                                                                                                                                                                                                                                                         |   | <b>ENVIRONMENTAL CHEMISTRY AND MICROBIOLOGY</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course category</b>                                                                                                                                                                                                                                                                                                                                 | : | Professional Elective - 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Pre-requisite Subject</b>                                                                                                                                                                                                                                                                                                                           | : | NIL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Contact hours/week</b>                                                                                                                                                                                                                                                                                                                              | : | Lecture: 3, Tutorial: 1, Practical: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Number of Credits</b>                                                                                                                                                                                                                                                                                                                               | : | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Course Assessment methods</b>                                                                                                                                                                                                                                                                                                                       | : | Continuous assessment through tutorials, attendance, home assignments, quizzes and One Minor test/s and One Major Theory Examination                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Course Objectives</b>                                                                                                                                                                                                                                                                                                                               | : | The course objectives are given below:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Course Outcomes</b>                                                                                                                                                                                                                                                                                                                                 | : | <p>The students are expected to demonstrate the following knowledge, skills and attitudes after completing this course.</p> <ol style="list-style-type: none"> <li>1. Synthesize and apply concepts from multiple sub-disciplines in environmental chemistry and toxicology.</li> <li>2. Use technical and analytical skills to quantify the level and effects of xenobiotics in environmental compartments (air, water, soil, biota).</li> <li>3. Identify relationships between chemical exposure and effects on physiological systems and design strategies for study of dose-response relationships.</li> <li>4. Effectively understand and convey scientific material from peer-reviewed sources.</li> <li>5. Conduct an individual research project within the university of other appropriate setting.</li> </ol> |
| <b>Topics Covered</b>                                                                                                                                                                                                                                                                                                                                  |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>UNIT-I</b>                                                                                                                                                                                                                                                                                                                                          |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Chemical composition of atmosphere- particles, ions and radicals; formation of particulate matter; photochemical and chemical reactions in the atmosphere; chemistry of greenhouse gases and ozone layer depletion; gaseous transformations in the atmosphere and removal mechanisms; photochemical smog; nuclear winter.                              |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>UNIT-II</b>                                                                                                                                                                                                                                                                                                                                         |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Chemical composition of lithosphere; water and air in soil; inorganic and organic components in soil; acid, base and ionexchange reaction in the soil; soil acidity, salinity and sodicity; effects of ecological factors on the toxicity of soil; Bio-geochemical cycles                                                                              |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>UNIT-III</b>                                                                                                                                                                                                                                                                                                                                        |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Basic concept of colloidal and quantitative chemistry. Oxidation-reduction reactions and equations; gas laws, equilibrium and Lechatelier's principle, activity and coefficients, variations in equilibrium relationships, shifting chemical equilibrium, amphoteric hydroxides, buffers and buffer index; solubility of salts, complex formation      |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>UNIT-IV</b>                                                                                                                                                                                                                                                                                                                                         |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Microorganisms and their association with man, animals and plants; Extremophilic microorganisms, Microbial metabolism; role of micro-organisms in environmental management. Neutron Activation Analysis; calorimetric; Colourimetry; Atomic Absorption Spectroscopy; Gas chromatography, HPLC, Ion exchange Chromatography and Polarography. XRF, XRD. |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Textbooks</b>                                                                                                                                                                                                                                                                                                                                       |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

1. Bailey R.A. (2002) Chemistry of the Environment, Academic Press, San Diego.

2. Masters G.M. (2004) Introduction to Environmental Engineering and Science, Second Edition, Pearson Education.

**Reference Books**

1. Baird C. (1999) Environmental Chemistry (2nd edition), WH Freeman and Co.

2. Buell P. and Girard J. (2002) Chemistry Fundamentals: An Environmental Perspective (2nd edition), Jones & Bartlett Publishers.

3. Bunce N. (1991) Environmental Chemistry, Wuerz Publishing Ltd., Winnipeg, Canada.

4. Cunningham W.P. and Cunningham M.A. (2007) Principles of Environmental Science: Inquiry and Applications, Tata McGraw-Hill.

5. Harrison R.M. (1991) Introductory Chemistry for the Environmental Sciences, Cambridge University Press.

6. Harrison R.M. (Edited) (1999) Understanding our Environment: An Introduction to Environmental Chemistry and Pollution, Royal Society of Chemistry.

7. Miller G.T. (2001) Environmental Science, (eighth edition), Brooks/Cole.

8. Pepper I.L., Gerba C.P. and Brusseau M.L. (2006) Environmental and Pollution Science, Second edition, Academic Press.

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| ECE 204                   | TRAFFIC ENGINEERING |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |  |
| Course category           | :                   | Professional Elective-2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |
| Pre-requisite Subject     | :                   | NIL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |  |
| Contact hours/week        | :                   | Lecture: 3, Tutorial: 1, Practical: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  |
| Number of Credits         | :                   | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |
| Course Assessment methods | :                   | Continuous assessment through tutorials, attendance, home assignments, quizzes and One Minor test/s and One Major Theory Examination                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |
| Course Objectives         | :                   | The course objectives are given below:<br>1. An ability to design the road with existing traffic capacity of the town /city.<br>2. Ability to calculate the traffic flow, traffic volume of the town/city.<br>3. Idea about the traffic signs.                                                                                                                                                                                                                                                                                                                                                        |  |
| Course Outcomes           | :                   | The students are expected to demonstrate the following knowledge, skills and attitudes after completing this course.<br><br>1. Knowledge of achieving efficient, free and rapid flow of traffic.<br>2. Knowledge of having fewer accidents and pedestrians should also be given importance.<br>3. Knowledge about the various types of signals and their uses.<br>4. Knowledge about deciding the signal timing for different traffic situations.<br>5. Knowledge of having different type of parking techniques and lighting<br>6. Knowledge of having various methods of travel demand forecasting. |  |
| Topics Covered            |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |  |
| UNIT-I                    |                     | 9                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |

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| Introduction to traffic analysis, operation and control including traffic capacity analysis, components and characteristics traffic system, statistical application in traffic operation, Design of Intersections                                                             |          |
| <b>UNIT-II</b>                                                                                                                                                                                                                                                                | <b>9</b> |
| Basics of traffic signal design and phase timing, analysis and design of pre-timed and phase timing, traffic modelling including computer applications. Signal coordination for arterials and networks, Arterial analysis planning and Design,                                |          |
| <b>UNIT-III</b>                                                                                                                                                                                                                                                               | <b>9</b> |
| Analysis of unsignalized intersections, Design of parking facility, Highway Lighting, Traffic planning and administration studies and their uses, traffic flow characteristics.                                                                                               |          |
| <b>UNIT-IV</b>                                                                                                                                                                                                                                                                | <b>9</b> |
| Traffic control devices, intersections, traffic planning, Trip generation models, trip distribution models, modal split analysis. Advanced methods for travel demand forecasting.                                                                                             |          |
| <b>Textbooks</b><br>1. Roess R.P., Prassas S.E, Mc- Shane W.R., Traffic Engineering, Prentice Hall, 2011.<br>2. Khanna K S., Justo C E G., Veeragavan A., Highway Engineering, Nem Chand & Bros, 2020.<br>3. Traffic Engineering by. L. R. Kadiyali Khanna publication, 2016. |          |
| <b>Reference Books</b><br>1. Papacostas S C., Prevedouros D P., Transportation Engineering, PHI publishers, 2016.<br>2. Chakroborty P., Principles of Transportation Engineering, PHI publishers, 2020.                                                                       |          |

### Syllabus For PE3 and PE4 Elective Subjects

|                                                                                                                                                                                                                                                                                                                                                                                                                                          |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |   |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
| <b>ECE 301</b>                                                                                                                                                                                                                                                                                                                                                                                                                           |   | <b>STRUCTURAL DYNAMICS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |   |
| <b>Course category</b>                                                                                                                                                                                                                                                                                                                                                                                                                   | : | Professional Elective-3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |   |
| <b>Pre-requisite Subject</b>                                                                                                                                                                                                                                                                                                                                                                                                             | : | NIL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |   |
| <b>Contact hours/week</b>                                                                                                                                                                                                                                                                                                                                                                                                                | : | Lecture: 3, Tutorial:1, Practical: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |   |
| <b>Number of credits</b>                                                                                                                                                                                                                                                                                                                                                                                                                 |   | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |   |
| <b>Course Assessment methods</b>                                                                                                                                                                                                                                                                                                                                                                                                         | : | Continuous assessment through tutorials, attendance, home assignments, quizzes, record, one Minor test and One Major Theory Examination.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |   |
| <b>Course Objective</b>                                                                                                                                                                                                                                                                                                                                                                                                                  |   | To introduce students to the fundamentals of structural dynamics, including modeling and idealization of structures, formulation of dynamic equilibrium, and analysis of SDOF and MDOF systems. The course covers structural response to various dynamic loads, eigenvalue analysis, mode superposition, discretization of continuous systems, and basic concepts of seismic design and soil-structure interaction.                                                                                                                                                                                                                                           |   |
| <b>Course Outcomes</b>                                                                                                                                                                                                                                                                                                                                                                                                                   | : | <p>The students are expected to be able to demonstrate the following: knowledge, skills and attitudes after completing this course</p> <ol style="list-style-type: none"><li>1. Relate the structural idealization to properties of real structure.</li><li>2. Able to establish dynamic equilibrium.</li><li>3. Able to solve the Eigen value problem and knowledge to its properties.</li><li>4. To calculate response from different types of loading.</li><li>5. Continuous systems; discretization; soil-structure interaction; seismic design concepts</li><li>6. MDOF systems; harmonic excitation; mode superposition; Lagrange's equations</li></ol> |   |
| <b>Topics Covered</b>                                                                                                                                                                                                                                                                                                                                                                                                                    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |   |
| <b>UNIT-I</b>                                                                                                                                                                                                                                                                                                                                                                                                                            |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 9 |
| Introduction to structural dynamics, definition of basic problem in dynamics, static versus dynamic loads, different types of dynamic loads. Sources of vibration, Degrees of freedom, Single degree of freedom systems: Free vibrations of undamped and viscously damped systems, Raleigh's Method, Damping in structures, viscous damping and coulomb damping, effect of damping on frequency of vibration and amplitude of vibration. |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |   |
| <b>UNIT-II</b>                                                                                                                                                                                                                                                                                                                                                                                                                           |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 9 |
| Structures modelled as shear buildings: Free vibration of shear building; Forced Vibration of Shear Buildings, logarithmic decrement, forced vibration, response to periodic loading, dynamic load factors, response of structure subjected to general dynamic load, Dulhamel's integral, numerical evaluation of dynamics response of SDOF systems.                                                                                     |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |   |
| <b>UNIT-III</b>                                                                                                                                                                                                                                                                                                                                                                                                                          |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 9 |
| Multiple degree of Freedom Systems, Response to harmonic excitation, Dynamic Analysis of beams, Dynamic Analysis of plane frames; mode superposition method Lagranges' equations, Eigen value problems; Linear Response of Multi Degree freedom systems.                                                                                                                                                                                 |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |   |
| <b>UNIT-IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                           |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 9 |
| Dynamic analysis of structures with distributed properties, Discretization of continuous systems, Introduction to seismology, effect of soil properties and damping on seismic performance of structure, concept of seismic design of RC Structure                                                                                                                                                                                       |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |   |

**Textbooks/ Reference books**

1. Hibler and Gupta (2010), Engineering Mechanics (Statics, Dynamics) by Pearson Education.
2. Dynamics of Structures, Anil K. Chopra, Prentice Hall, India.
3. Dynamics of Structures, Cloguh & Penzein, Tata McGraw Hill. New Delhi
4. Structural Dynamics, John M. Biggs, Tata McGraw Hill. New Delhi

| <b>ECE 302</b>                                                                                                                                                                                                                                                                              |   | <b>GROUND IMPROVEMENT TECHNIQUES</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course category</b>                                                                                                                                                                                                                                                                      | : | Professional Elective-3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Pre-requisite Subject</b>                                                                                                                                                                                                                                                                | : | Knowledge of Basic soil mechanics is required                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Contact hours/week</b>                                                                                                                                                                                                                                                                   | : | Lecture:3, Tutorial: 1, Practical:0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Number of Credits</b>                                                                                                                                                                                                                                                                    | : | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Course Assessment methods</b>                                                                                                                                                                                                                                                            | : | Continuous assessment through tutorials, attendance, home assignments, quizzes, and One Minor tests and One Major Theory Examination.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Course Objectives</b>                                                                                                                                                                                                                                                                    | : | To provide students with a clear understanding of soil behavior and the need for ground improvement techniques, and to develop the ability to select and apply suitable methods such as compaction, stabilization, in-situ densification, preloading, dewatering, grouting, granular piles, and underpinning to improve the engineering performance of soils under different field conditions.                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Course Outcomes</b>                                                                                                                                                                                                                                                                      | : | <p>The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course</p> <ol style="list-style-type: none"> <li>1. Analyze soil properties and assess the need for ground improvement techniques.</li> <li>2. Apply compaction and soil stabilization methods for improving engineering properties of soil.</li> <li>3. Evaluate and select suitable in-situ densification techniques for granular soils.</li> <li>4. Examine improvement methods for cohesive soils including preloading and vertical drains.</li> <li>5. Design and analyze grouting, granular piles, and underpinning techniques.</li> <li>6. Recommend appropriate ground improvement methods based on soil conditions and site requirements.</li> </ol> |
| <b>Topics Covered</b>                                                                                                                                                                                                                                                                       |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>UNIT-I</b>                                                                                                                                                                                                                                                                               |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Introduction and Soil Stabilization:</b> Introduction to ground improvement, review of compaction theory, effect of compaction on soil behavior, field methods of compaction, quality control in compaction, design of soil-lime, soil-cement, soil-bitumen and soil-lime-fly-ash mixes. |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>UNIT-II</b>                                                                                                                                                                                                                                                                              |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>In-situ Densification in Granular Soils:</b> In-situ densification methods in granular soils, deep compaction: introduction, Terra-Probe, vibroflotation techniques, ground suitability for                                                                                              |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |



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| vibroflotation, advantages, Mueller Resonance Compaction, dynamic compaction, depth of improvement.                                                                                                                                                                                                                                                                                     |          |
| <b>UNIT-III</b>                                                                                                                                                                                                                                                                                                                                                                         | <b>9</b> |
| <b>In-situ Improvement in Cohesive Soils:</b> In-situ densification methods in cohesive soils, pre-loading and de-watering, vertical drains, electrical method, thermal method.                                                                                                                                                                                                         |          |
| <b>UNIT-IV</b>                                                                                                                                                                                                                                                                                                                                                                          | <b>9</b> |
| <b>Grouting and Foundation Improvement Techniques:</b> Grouting: introduction, suspension grout, solution grout, grouting equipment and methods, grouting design and layout. Granular piles: ultimate bearing capacity and settlement, method of construction, load test. Underpinning of foundations: importance, situations requiring underpinning, methodology and typical examples. |          |
| <b>Textbooks</b><br>1. Purshotham Raj – <i>Ground Improvement</i> , Pearson Education India.                                                                                                                                                                                                                                                                                            |          |
| <b>Reference books</b><br>1. S. K. Garg – Soil Mechanics and Foundation Engineering<br>2. A. K. Samadhiya – Ground Improvement Techniques<br>3. Gopal Ranjan and A. S. Rao – Basic and Applied Soil Mechanics<br>4. J. N. Mandal – Geosynthetics World<br>5. Bergado et al. – Soft Ground Improvement<br>6. Koerner, R. M. – Designing with Geosynthetics                               |          |

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| <b>ECE 303</b>                   | <b>ENVIRONMENTAL PLANNING AND MANAGEMENT</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Course category</b>           | : Professional Elective-3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Pre-requisite Subject</b>     | : NIL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Contact hours/week</b>        | : Lecture: 3, Tutorial:1, Practical: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Number of credits</b>         | : 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Course Assessment methods</b> | : Continuous assessment through tutorials, attendance, home assignments, quizzes, record, o n e Minor test and One Major Theory Examination.                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Course Objective</b>          | The main objective is to expand the student knowledge of the principles and practices of environmental sustainability, planning, and protection. The student after learn to integrate environmental, social, and economic dimensions for informed decision-making in sustainable development and resource management.                                                                                                                                                                                                                                                                  |
| <b>Course Outcomes</b>           | : The students are expected to be able to demonstrate the following: knowledge, skills and attitudes after completing this course<br>1. To understand the basic theory of environment and sustainable development.<br>2. To study the engineering methodology in planning and its limitations.<br>3. To study the environmental protection<br>4. To study the Environmental impact assessment and environmental economics.<br>5. To have adequate knowledge on total quality management in environmental management and protection.<br>6. To understand about the Environmental audit. |
| <b>Topics Covered</b>            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

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| <b>UNIT-I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>9</b> |
| Environment and Sustainable Development - carrying capacity, relationship with quality of life, carrying, indicators of sustainability, sustainability strategies, barriers to sustainability, resource utilization, resource degradation, industrial ecology, socio economic policies for sustainable development and clean development mechanism.                                                                                                                                                                                                                                                                                                       |          |
| <b>UNIT-II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>9</b> |
| Engineering Methodology in Planning and Its Limitations - carrying capacity based short and long-term regional planning. Environmental impact assessment (EIA) - definitions and concepts, rationale and historical development of EIA, sustainable development, initial environmental examination, environmental impact statement, environmental appraisal, environmental impact factors and areas of consideration, measurement of environmental impact, organization, scope and methodologies of EIA, status of EIA in India.                                                                                                                          |          |
| <b>UNIT-III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>9</b> |
| Environmental Protection - Economic development and social welfare consideration in socio economic developmental policies and planning. Total cost of development and environmental protection cost. Case studies on Regional carrying capacity. Engineering Economics - Value Engineering, Time Value of Money, Cash Flows, Budgeting and Accounting. Environmental Economics: Introduction, economic tools for evaluation, Green GDP, Cleaner development mechanisms and their applications.                                                                                                                                                            |          |
| <b>UNIT-IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>9</b> |
| Environmental Audit - methods, procedure, environmental audit versus accounts audit, compliance audit, methodologies and regulations reporting and case studies, Life cycle assessment; Triple bottom line approach. Total Quality Management in Environmental Management and Protection - ISO 9000, 14000 and 18000 series of standards.                                                                                                                                                                                                                                                                                                                 |          |
| <b>Textbooks/ Reference books</b> <ol style="list-style-type: none"> <li>1. Lohani B.N and North A.M., (1984)., "Environmental Quality Management", South Asian Publishers, New Delhi.</li> <li>2. Chanlett E.T., (1979), Environmental Protection, McGraw Hill Publication, New York.</li> <li>3. Danoy G.E., and Warner R.F., (1989), "Planning and Design of Engineering Systems", First Edition, CRC press, Unwin Hyman Publications.</li> <li>4. MOEF, Government of India, "Carrying Capacity Based Developmental Planning Studies for the National Capital Region", 1995-96.</li> <li>5. NEERI, Nagpur, Annual Reports 1995 &amp; 1996.</li> </ol> |          |

| <b>ECE 304</b>                   |   | <b>RAILWAY AND AIRPORT ENGINEERING</b>                                                                                               |  |
|----------------------------------|---|--------------------------------------------------------------------------------------------------------------------------------------|--|
| <b>Course category</b>           | : | Professional Elective-3                                                                                                              |  |
| <b>Pre-requisite Subject</b>     | : | NIL                                                                                                                                  |  |
| <b>Contact hours/week</b>        | : | Lecture:3, Tutorial: 1, Practical:0                                                                                                  |  |
| <b>Number of Credits</b>         | : | 4                                                                                                                                    |  |
| <b>Course Assessment methods</b> | : | Continuous assessment through tutorials, attendance, home assignments, quizzes, and One Minor test and One Major Theory Examination. |  |
| <b>Course Objectives</b>         | : | To make the students understands the basic of component of railway and airport engineering and their design.                         |  |

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| <b>Course Outcomes</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | : | <p>The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course</p> <ol style="list-style-type: none"> <li>1. Understand the knowledge of various systems of railway, airport, and water transportation.</li> <li>2. Understand the components of railway tracks, components, and types of air crafts etc.</li> <li>3. Understand the design concept of railway track, runway, taxiway.</li> <li>4. Apply the concept of geometric design of railway, runway, taxiway, docks &amp; harbours etc.</li> <li>5. Apply the knowledge of various signaling system for railway engineering, air traffic control, navigational aids, etc.</li> <li>6. Understand the concepts of air traffic control, navigational aids, etc.</li> </ol> |
| <b>Topics Covered</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>UNIT I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Indian Railways: Development and organization of Indian Railways. Permanent way: Sub-grade formation, embankment and cutting, track damage. Rails: Rail gauges, types of rails, defects in rails, rail failure, creep of rail. Rail Fastenings: Fish plates, spikes, chairs, keys, bearing plates. Sleepers: Timber, steel, cast iron, concrete and prestressed concrete sleepers, manufacturing of concrete sleepers, sleeper density. Ballast: Ballast materials, size of ballast, screening of ballast, specification of ballast, tests on ballast. |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>UNIT II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Railway Track Geometry: Gradients, horizontal curves, super elevation, safe speed on curves, can't deficiency, negative super elevation, compensation for curvature on gradients, track resistance and tractive power. Points and Crossings: Elements of simple turn-out, details of switch, details of crossings, number and angle of crossings, design of turn-out.                                                                                                                                                                                  |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>UNIT III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Stations & Yards: Site section for a railway station, layout of different types of stations, classification of stations, types of railway yard, functioning of Marshalling yards. Signaling and Interlocking: Classification of signals, methods of train working, absolute block system, mechanical interlocking of two-line railway stations.                                                                                                                                                                                                        |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>UNIT IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Airport Engineering: Aircraft characteristics, types of airports, layout of airports, airport planning and design, runway orientation, wind-rose diagram, estimation of runway length and correction.                                                                                                                                                                                                                                                                                                                                                  |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Textbooks</b> <ol style="list-style-type: none"> <li>1. A Textbook of Railway Engineering by S. P. Arora &amp; S. C. Saxena.</li> <li>2. Airport Planning and Design by S. K. Khanna, M. G. Arora</li> </ol> <b>Reference books</b> <ol style="list-style-type: none"> <li>1. Railway Engineering - M.M. Aggarwal.</li> <li>2. Railway Engineering - Vasvani.</li> </ol>                                                                                                                                                                            |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

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| <b>ECE 305</b>                   | <b>SOIL WATER CONSERVATION</b>                                                                                                  |
| <b>Course Category</b>           | Professional Elective-3                                                                                                         |
| <b>Contact hours/week</b>        | Lecture – 3; Tutorial – 1; Practical – 0                                                                                        |
| <b>Number of credits</b>         | 4                                                                                                                               |
| <b>Course assessment methods</b> | Continuous assessment through tutorials, attendance, home assignments, quizzes, One minor test and One Major Theory Examination |

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| <b>Course Objectives</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | To make the students understand about the measurement techniques for soil loss and wind erosion, and to know the different agronomical and engineering measures adopted for its control along with its design.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Course Outcomes</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <p>The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course</p> <ol style="list-style-type: none"> <li>1. Have an understanding of various types of soil, water and wind erosion along with its mitigation measures.</li> <li>2. Acquire proficiency in application of universal soil loss equation for estimating soil loss/erosion from an area</li> <li>3. Have a thorough knowledge on causes of water erosion and its control measures</li> <li>4. Know about the agronomic and engineering methods of conservation and the design of bunds and terraces being implemented on the field.</li> <li>5. Understand the causes of wind erosion, and methods for controlling wind erosion</li> <li>6. Be able to provide practical solutions to minimise the erosion loss and conservation of soil.</li> </ol> |
| <b>Topics Covered</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Unit I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Soil erosion - Introduction, causes and types; Geological and accelerated erosion; Erosion agents; Factors affecting and effects of erosion. Soil loss estimation – Universal soil loss equation (USLE) and modified USLE; Rainfall erosivity - estimation by KE>25 and EI 30 methods; Soil erodibility and other management factors. Measurement of soil erosion - Runoff plots, soil samplers.                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Unit II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Water erosion - Mechanics and forms; Gullies –Classification & stages of development; Water erosion control measures - agronomical measures - contour farming, strip cropping, conservation tillage and mulching; Engineering measures– Bunds and terraces. Bunds - contour and graded bunds - design and surplus arrangements                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Unit III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Terraces - level and graded broad base terraces, bench terraces - planning, design and layout procedure, contour stonewall and trenching. Gully and ravine reclamation - principles of gully control - vegetative measures, temporary structures and diversion drains. Grassed waterways and design                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Unit IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Wind erosion-</b> Factors affecting, mechanics, soil loss estimation and control measures vegetative, mechanical measures. Design of wind breaks and shelter belts and stabilization of sand dunes; Land capability classification. Rate of sedimentation, silt monitoring and storage loss in tanks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Textbooks</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <ol style="list-style-type: none"> <li>1. Frevert, R.K., G.O. Schwab, T.W. Edminster and K.K. Barnes. 2009. Soil and Water Conservation Engineering, 4th Edition, John Wiley and Sons, New York.</li> <li>2. Norman Hudson. 1985. Soil Conservation. Cornell University Press, Ithaka, New York, USA. Singh Gurmel, C. Venkataraman, G. Sastry and B.P. Joshi. 1996. Manual of Soil and Water</li> <li>3. Conservation Practices. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.</li> <li>4. Suresh, R. 2014. Soil and Water Conservation Engineering. Standard Publisher Distributors, New Delhi.</li> <li>5. Michael, A.M. and T.P. Ojha. 2003. Principles of Agricultural Engineering. Volume II. 4th Edition, Jain Brothers, New Delhi.</li> <li>6. Murthy, V.V.N. 2002. Land and Water Management Engineering. 4th Edition, Kalyani Publishers, New Delhi</li> </ol> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

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| <b>ECE 306</b>                                                                                                                                                                                                                                                                                                                                                                                         | <b>PRINCIPLES OF REMOTE SENSING</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Course category</b>                                                                                                                                                                                                                                                                                                                                                                                 | :                                   | Professional Elective-3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Pre-requisite Subject</b>                                                                                                                                                                                                                                                                                                                                                                           | :                                   | NIL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Contact hours/week</b>                                                                                                                                                                                                                                                                                                                                                                              | :                                   | Lecture:3, Tutorial:1, Practical:0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Number of Credits</b>                                                                                                                                                                                                                                                                                                                                                                               | :                                   | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Course Assessment methods</b>                                                                                                                                                                                                                                                                                                                                                                       | :                                   | Continuous assessment through tutorials, attendance home assignments, quizzes, and one Minor tests, and One Major Theory examination                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Course Objectives</b>                                                                                                                                                                                                                                                                                                                                                                               | :                                   | To learn the principles of remote sensing phenomenon including image acquisition, analysis and processing to extract information                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Course Outcomes</b>                                                                                                                                                                                                                                                                                                                                                                                 | :                                   | <p>The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course</p> <ol style="list-style-type: none"> <li>1. Understand the way in which electromagnetic radiation interacts with the earth's atmosphere, the earth's surface and the remote sensing system.</li> <li>2. Be familiar with different types of sensors and remote sensing space missions that are used to detect and record certain parts of the electromagnetic spectrum.</li> <li>3. Develop some skills in image interpretation and analysis by understanding simple image enhancement, filtering operations over digital images</li> <li>4. To carry out corrections of geometric distortions in digital images</li> <li>5. Develop a knowledge and understanding of spectral classification of images for feature extraction</li> <li>6. Awareness of some applications of remotely sensed images</li> </ol> |
| <b>Topics Covered</b>                                                                                                                                                                                                                                                                                                                                                                                  |                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>UNIT I</b>                                                                                                                                                                                                                                                                                                                                                                                          |                                     | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Remote sensing system and its components, Electromagnetic spectrum, definition of emissivity, reflectance, absorbance and transmittance. Spectral signature, atmospheric window, active and passive remote sensing systems, Interaction of electromagnetic energy with atmosphere and earth features, factors affecting the reflectance                                                                |                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>UNIT II</b>                                                                                                                                                                                                                                                                                                                                                                                         |                                     | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Airborne and space platforms, Advantages and disadvantages of each, principle and functioning of multi-spectral, thermal & line scanners, Multi concept of remote sensing, Different satellite and sensor combinations: LANDSAT, SPOT, IRS series of satellites and sensors. Their important characteristics: such as flight altitude, IFOV, spatial resolution, swath, spectral bands, and repetivity |                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>UNIT III</b>                                                                                                                                                                                                                                                                                                                                                                                        |                                     | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Introduction to Digital Image Processing, digital image representation, and characterization, Concept of color, Color composites, histograms and scatter plot, image enhancement, contrast stretching, radiometric processing including correction of atmospheric corrections; geometric corrections, Image Transformations such as subtraction, ratioing, NDVI and PCA                                |                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>UNIT IV</b>                                                                                                                                                                                                                                                                                                                                                                                         |                                     | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Ground truth: Geographic and Radiometric, Principles of Global Positioning Systems and its role to remote sensing data, Digital terrain models. Thematic classification and clustering to include unsupervised and supervised classification based on parallelepiped, minimum distance and maximum likelihood classification, accuracy assessment of classification. Applications of remote sensing    |                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

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| <b>Textbooks</b>       |                                                                                                      |
| 1.                     | Thomas Lillesand, Ralph W. Kiefer, Jonathan Chipman., Remote Sensing and Image Interpretation. Wiley |
| 2.                     | Reddy, M. Anji, Remote sensing and Geographic Information System BS Publications                     |
| 3.                     | B. Bhatta, Remote Sensing and GIS, Oxford University Press                                           |
| <b>Reference books</b> |                                                                                                      |
| 1.                     | Curran, Paul J., Principles of Remote sensing Longman                                                |
| 2.                     | Campbell, J.B., Introduction of Remote Sensing Taylor and Francis                                    |
| 3.                     | Sabins, F.F., Remote Sensing: Principles and Interpretations Waveland Pr Inc Publishers              |

| ECE 401                                                                                                                                                                                                                                                                                                                                                                                                                                                  |   | DESIGN OF BRIDGES                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course category</b>                                                                                                                                                                                                                                                                                                                                                                                                                                   | : | Professional Elective-4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Pre-requisite Subject</b>                                                                                                                                                                                                                                                                                                                                                                                                                             | : | Structural Mechanics (BCE 212)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Contact hours/week</b>                                                                                                                                                                                                                                                                                                                                                                                                                                | : | Lecture: 3, Tutorial:1, Practical: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Number of credits</b>                                                                                                                                                                                                                                                                                                                                                                                                                                 | : | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Course Assessment Methods</b>                                                                                                                                                                                                                                                                                                                                                                                                                         | : | Continuous assessment through tutorials, attendance, home assignments, quizzes, record, one minor tests, and one Major Theory Examination.                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Course Objectives</b>                                                                                                                                                                                                                                                                                                                                                                                                                                 | : | The objective of this course is to provide students with fundamental and applied knowledge of planning, analysis, design and maintenance of bridges. The course emphasizes hydrological considerations, IRC loading standards, structural design of superstructure and substructure components, and modern construction practices.                                                                                                                                                                                                                                                |
| <b>Course Outcomes</b>                                                                                                                                                                                                                                                                                                                                                                                                                                   | : | After completion of the course, students will be able to: <ol style="list-style-type: none"> <li>1. Explain bridge components, classification and planning aspects.</li> <li>2. Estimate flood discharge, waterway and scour depth for bridge design.</li> <li>3. Apply IRC loadings and analyze bridge superstructures.</li> <li>4. Design basic superstructure components such as slab, T-beam bridges and culverts.</li> <li>5. Analyze and design substructures and foundations.</li> <li>6. Understand bearings, joints, construction and maintenance of bridges.</li> </ol> |
| <b>Topics Covered</b>                                                                                                                                                                                                                                                                                                                                                                                                                                    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>UNIT-I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                            |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Introduction to bridge components and classification. Importance of bridge investigation and site selection. Hydrological considerations including estimation of design flood discharge, linear waterway and scour depth. Selection of bridge type, subsoil exploration and location of piers and abutments. IRC specifications for road bridges including carriageway width, standard IRC loadings and live load calculation by Effective Width Method. |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>UNIT-II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                           |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| General design considerations and load combinations. Design of pipe culvert, slab bridge, box culvert and RCC T-beam bridge. Introduction to load distribution methods. Basic concepts of balanced cantilever bridges and prestressed concrete bridges.                                                                                                                                                                                                  |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>UNIT-III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                          |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

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| Types of bridge substructures and forces acting on them. Design principles of piers and abutments including stability checks. Types of bridge foundations such as open, pile and well foundations and their selection criteria.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |          |
| <b>UNIT-IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>9</b> |
| Importance and types of bridge bearings and expansion joints. Design principles of elastomeric bearings. Construction procedures of RCC and PSC bridges. Maintenance, inspection, load testing and assessment of load carrying capacity of bridges.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |          |
| <b>Textbooks:</b> <ol style="list-style-type: none"> <li>1. Ponnuswamy, S. (2014). <i>Bridge Engineering</i> (3rd ed.). New Delhi: Tata McGraw-Hill Education.</li> <li>2. Krishnam Raju, N. (2010). <i>Design of Bridges</i>. New Delhi: Oxford &amp; IBH Publishing Co. Pvt. Ltd.</li> </ol> <b>Reference books:</b> <ol style="list-style-type: none"> <li>1. Victor, D. J. (2001). <i>Essentials of Bridge Engineering</i>. New Delhi: Oxford &amp; IBH Publishing Co. Pvt. Ltd.</li> <li>2. Indian Roads Congress. (Latest Edition). <i>Standard Specifications and Code of Practice for Road Bridges (IRC: 6 – Loads and Stresses; IRC: 21 – Cement Concrete; IRC: 78 – Foundations and Substructure)</i>. New Delhi: IRC.</li> <li>3. Johnson, R. P. (2004). <i>Composite Structures of Steel and Concrete</i> (3rd ed.). Oxford: Blackwell Publishing.</li> <li>4. Hambly, E. C. (1991). <i>Bridge Deck Behaviour</i> (2nd ed.). London: Chapman &amp; Hall.</li> </ol> |          |

| ECE 402                          |   | GEOSYNTHETICS ENGINEERING                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
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| <b>Course category</b>           | : | Professional Elective-4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Pre-requisite Subject</b>     | : | Soil Mechanics (BCE 211)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Contact hours/week</b>        | : | Lecture : 3, Tutorial : 1, Practical: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Number of Credits</b>         | : | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Course Assessment methods</b> | : | Continuous assessment through tutorials, attendance, home assignments, quizzes and One Minor Test and One Major Theory Examination                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Course Objectives</b>         | : | To enable students to understand the fundamental concepts and functions of geosynthetics, the analysis and design of reinforced soil structures, and advanced geosynthetic applications in ground improvement, drainage, environmental protection, and foundation systems.                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Course Outcomes</b>           | : | <p>The students are expected to demonstrate the following knowledge, skills and attitudes after completing this course</p> <ol style="list-style-type: none"> <li>1. Explain different types, properties, and manufacturing processes of geosynthetics.</li> <li>2. Evaluate strength and testing requirements of reinforced soil and geosynthetic materials.</li> <li>3. Analyze external and internal stability of geosynthetic reinforced retaining walls under static and seismic loading.</li> <li>4. Design reinforced soil slopes, embankments, and shallow foundation support systems using geosynthetics.</li> <li>5. Apply geosynthetics for drainage, filtration, erosion control, and environmental engineering applications.</li> </ol> |

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|                                                                                                                                                                                                                                                                                                     |  | 6. Assess ground improvement techniques such as accelerated consolidation and geosynthetic encased stone columns. |
| <b>Topics Covered</b>                                                                                                                                                                                                                                                                               |  |                                                                                                                   |
| <b>UNIT-I</b>                                                                                                                                                                                                                                                                                       |  | <b>9</b>                                                                                                          |
| Introduction, types and applications & manufacturing of geosynthetics, strength of reinforced soils, testing of geosynthetics, drainage applications of geosynthetics, filtration applications of geosynthetics, erosion control using geosynthetics, natural geosynthetics and their applications. |  |                                                                                                                   |
| <b>UNIT-II</b>                                                                                                                                                                                                                                                                                      |  | <b>9</b>                                                                                                          |
| Types of soil retaining structures, construction aspect of geosynthetic-reinforced retaining walls, internal and external stability analysis, testing requirements, and design for simple geometry with sloped backfill.                                                                            |  |                                                                                                                   |
| <b>UNIT-III</b>                                                                                                                                                                                                                                                                                     |  | <b>9</b>                                                                                                          |
| Stability analysis of reinforced soil slopes resting on soft and strong foundation soils, bilinear wedge analysis, design of embankments supported on load transfer platforms, reinforced soil for supporting shallow foundations.                                                                  |  |                                                                                                                   |
| <b>UNIT-IV</b>                                                                                                                                                                                                                                                                                      |  | <b>9</b>                                                                                                          |
| Accelerated consolidation of soft clays using geosynthetics, geosynthetic encased stone columns for load support, geosynthetics for construction of municipal and hazardous waste landfills.                                                                                                        |  |                                                                                                                   |
| <b>Textbooks</b>                                                                                                                                                                                                                                                                                    |  |                                                                                                                   |
| 1. Koerner, R.M. (2012) Designing with Geosynthetics, Vols. 1 & 2, 6th Edition, Xlibris Corporation, USA.                                                                                                                                                                                           |  |                                                                                                                   |
| <b>Reference Books</b>                                                                                                                                                                                                                                                                              |  |                                                                                                                   |
| 2. Almeida, M. and Marques, M.E.S. (2013) Design and Performance of Embankments on Very Soft Soils, CRC Press, London, U.K.                                                                                                                                                                         |  |                                                                                                                   |
| 3. Hausmann, M.R. (1976) Engineering Principles of Ground Modification, McGraw-Hill, New York, USA.                                                                                                                                                                                                 |  |                                                                                                                   |
| 4. Kempfert, H.G. and Gebreselassie, B. (2006) Excavations and Foundations in Soft Soils, Springer, The Netherlands.                                                                                                                                                                                |  |                                                                                                                   |
| 5. Jewell, R.A. (1996) Soil Reinforcement with Geotextiles, CIRIA & Thomas Telford, London, U.K.                                                                                                                                                                                                    |  |                                                                                                                   |
| 6. John, N.W.M. (1987) Geotextiles, Blackie & Son Ltd., London, U.K.                                                                                                                                                                                                                                |  |                                                                                                                   |
| 7. Jones, C.J.F.P. (2010) Earth Reinforcement and Soil Structures, Thomas Telford, London, U.K.                                                                                                                                                                                                     |  |                                                                                                                   |
| 8. Saran, Swami (2006) Reinforced Soil and its Engineering Applications, I.K. International, New Delhi.                                                                                                                                                                                             |  |                                                                                                                   |
| 9. Shukla, S.K. (2012) Handbook of Geosynthetic Engineering, 2nd Edition, ICE Publishing, London, U.K..                                                                                                                                                                                             |  |                                                                                                                   |

| <b>ECE 403</b>                   |   | <b>DISASTER MANAGEMENT</b>                                                                                                         |
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| <b>Course category</b>           | : | Professional Elective-4                                                                                                            |
| <b>Pre-requisite Subject</b>     | : | NIL                                                                                                                                |
| <b>Contact hours/week</b>        | : | Lecture : 3, Tutorial : 1, Practical: 0                                                                                            |
| <b>Number of Credits</b>         | : | 4                                                                                                                                  |
| <b>Course Assessment methods</b> | : | Continuous assessment through tutorials, attendance, home assignments, quizzes and One Minor Test and One Major Theory Examination |



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| <b>Course Objectives</b>                                                                                                                                                                                                                                                                | : | To familiarize students with management measures to mitigate the consequences resulting from natural or human induced disasters                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Course Outcomes</b>                                                                                                                                                                                                                                                                  | : | <p>The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course</p> <ol style="list-style-type: none"> <li>1. Discuss the various modes of disaster arising in different areas</li> <li>2. Identify the roles of NDRF and SDRF in disaster management</li> <li>3. Illustrate the various trends of disaster management in Indian context</li> <li>4. Recommend the various disaster prevention techniques for different context.</li> <li>5. Define the role of engineers in Disaster mitigation</li> <li>6. Understand the concepts of disaster factors.</li> </ol> |
| <b>Topics Covered</b>                                                                                                                                                                                                                                                                   |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>UNIT I</b>                                                                                                                                                                                                                                                                           |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Type of disasters, Accent on land slides, earthquakes, flash flood, avalanches, snow blizzards. Causes, consequences and mitigation techniques, Flash floods their management and relief, Contingency planning for dam failures                                                         |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>UNIT II</b>                                                                                                                                                                                                                                                                          |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Characteristics of glaciers and protection of important monuments from glacial flow, Management of snow avalanche, Disaster management planning, Roles of NDRF and SDRF in Disaster Management                                                                                          |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>UNIT III</b>                                                                                                                                                                                                                                                                         |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Landslides, their classification, causes, & preventive measures. Concept, growth presents trends status in India and concept of contingency planning and systems approach of disaster management. Sociology of disasters, Human and media response and role.                            |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>UNIT IV</b>                                                                                                                                                                                                                                                                          |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Disaster prevention techniques, Disaster legislation, Disaster prone area building codes, Vulnerability analysis, Health and sanitation aspects, Relief administration in India and role of engineers in disaster mitigation                                                            |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Textbooks</b><br>1. Disaster Management and Strategies by Ashu Pasricha, Kiyounoush Ghalav and Jai Narain Sharma<br><b>Reference books</b><br>1. Disaster Management and Preparedness - Larry R. Collins, CRC Press.<br>2. Disaster Management Handbook - Jack Pinkowski, CRC Press. |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

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| <b>ECE 404</b>                   | <b>PAVEMENT ANALYSIS AND DESIGN</b> |                                                                                                                                      |
| <b>Course category</b>           | :                                   | Professional Elective-4                                                                                                              |
| <b>Pre-requisite Subject</b>     | :                                   | Highway Engineering (BCE 263)                                                                                                        |
| <b>Contact hours/week</b>        | :                                   | Lecture:3, Tutorial: 1, Practical:0                                                                                                  |
| <b>Number of Credits</b>         | :                                   | 4                                                                                                                                    |
| <b>Course Assessment methods</b> | :                                   | Continuous assessment through tutorials, attendance, home assignments, quizzes, and One Minor Test and One Major Theory Examination. |
| <b>Course Objectives</b>         | :                                   | To make the students to understand various approaches of analysis and design of flexible and rigid pavements                         |

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| <b>Course Outcomes</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | : | <p>The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course</p> <ol style="list-style-type: none"> <li>1. Understand about pavement and distinguishes the types of road pavement</li> <li>2. Knows the factors affect the pavement design and their characteristics.</li> <li>3. Apply the elastic layered theory to analyse the pavement.</li> <li>4. Design of the flexible pavements for highways</li> <li>5. Design of rigid pavement for highways.</li> <li>6. Ability to design rigid and flexible pavements</li> </ol> |
| <b>Topics Covered</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>UNIT I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Introduction: Definition of Pavement, Need of Pavement, Function of Pavements, Pavement Components and Its Functions, Types of Pavements, Difference between Flexible and Rigid Pavements, and Choice of Pavement Type, Composite Pavement, Perpetual Pavement.                                                                                                                                                                                                                                                                                                                                                |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>UNIT II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Factors Affecting Pavements Design: Traffic – Traffic Volume, Wheel Configuration, Axle Load, VDF, LDF, Contact area and tyre inflation pressure, ESWL, Repetitions of load and impact, Material Characteristics- CBR, Modulus of Subgrade Reaction, Resilient Modulus of Materials, Elastic Modulus, Poissons Ratio, Sub Grade Soil Condition, Visco-Elastic Behaviour of Bituminous Mix.                                                                                                                                                                                                                     |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>UNIT III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Analysis of Flexible Pavement: Homogeneous Mass, Layered System, Elastic Theory, Two Layer and Multi Layers Pavement, Analysis Using IIT Pave. Flexible Pavement Design: Design of Flexible Pavement Using IRC-37 and AASHTO Method, Design of Shoulders                                                                                                                                                                                                                                                                                                                                                       |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>UNIT IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Analysis of Rigid Pavement: Slab on Elastic Foundation, Stresses in Concrete Pavement, Westergaard Theory, Radius of Relative Stiffness, Load Stress, Temperature Gradient, Temperature Stress, Stresses Due to Friction, Combination of Stresses, Rigid Pavement Design: Design Factor, Westergaard's Theory of Local Stresses, Bradbury's Equation, Critical Combination of Stresses in Cement Concrete Pavement, Design of Joints in Concrete Pavements, Design of Dowel Bars, IRC Method, AASHTO Method                                                                                                    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Textbooks</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <ol style="list-style-type: none"> <li>1. Khanna, S. K. and Justo, C. e. G., Highway Engineering, Nemchand Bros., Roorkee</li> <li>2. Huang, Y. H., Pavement analysis and Design. Prentice Hall, Englewood Cliffs, New Jersey</li> </ol>                                                                                                                                                                                                                                                                                                                                                                       |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Reference books</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <ol style="list-style-type: none"> <li>1. Yoder and Whitejack, Pavement Design, John Wiley &amp; Sons.</li> <li>2. Flaherty, O. Highways-Location Design, Construction and Maintenance of Pavements, Taylor and Francis.</li> <li>3. Rajib B. Mallick and Tahar El-Korchi - Pavement Engineering: Principles and Practice.</li> <li>4. IRC: 37-2001, "Guidelines for the Design of Flexible Pavements (Second Revision)".</li> <li>5. IRC: 58-2001, "Guidelines for the Design of Plain Jointed Rigid Pavements for Highways (Second Revision)".</li> <li>6. AASHTO – Design of pavement Structures</li> </ol> |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>ECE 405</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>ADVANCED FLUID MECHANICS</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Course category</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | :                               | Professional Elective-4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Pre-requisite Subject</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | :                               | Fluid Mechanics (BCE 214)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Contact hours/week</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | :                               | Lecture : 3, Tutorial : 1, Practical: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Number of Credits</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | :                               | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Course Assessment methods</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | :                               | Continuous assessment through tutorials, attendance, home assignments, quizzes and One Minor Test and One Major Theory Examination                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Course Objectives</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | :                               | To make students understand advanced concepts in fluid mechanics such as viscous flow, including laminar flow and turbulent flow and compressible fluid flows.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Course Outcomes</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | :                               | <p>The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course</p> <ol style="list-style-type: none"> <li>1. Understanding the concept of fluid and the models of fluids.</li> <li>2. Understanding the basic physical meaning of general equations.</li> <li>3. Understanding the concept of stream function and potential function.</li> <li>4. Ability to derive the equation for viscous flow, including laminar flow and turbulent flow.</li> <li>5. Ability to address such problems in engineering, and to solve the problems</li> <li>6. Knowledge about compressible fluid flows</li> </ol> |
| <b>Topics Covered</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>UNIT I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                 | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Lagrangian and Eulerian Descriptions of fluid motion- Path lines, Stream lines, Streak lines, stream tubes – velocity of a fluid particle, types of flows, Equations of three-dimensional continuity equation- Stream and Velocity potential functions. Basic Laws of fluid Flow: Condition for irrotationality, circulation & vorticity Accelerations in Cartesian systems normal and tangential accelerations, Euler's, Bernoulli equations in 3D– Continuity and Momentum Equations                                                                                                |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>UNIT II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                 | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Prandtl's contribution to real fluid flows – Prandtl's boundary layer theory - Boundary layer thickness for flow over a flat plate – Von-Karman momentum integral equation - Blasius solution- Laminar boundary layer – Turbulent Boundary Layer — Expressions for local and mean drag coefficients for different velocity profiles. – Total Drag due to Laminar & Turbulent Layers – Problems                                                                                                                                                                                        |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>UNIT III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                 | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Fundamental concept of turbulence – Time Averaged Equations – Boundary Layer Equations - Prandtl Mixing Length Model - Universal Velocity Distribution Law: Van Driest Model – Approximate solutions for drag coefficients – More Refined Turbulence Models – k-epsilon model - boundary layer separation and form drag – Karman Vortex Trail, Boundary layer control, lift on circular cylinders; Internal Flow: Smooth and rough boundaries – Equations for Velocity Distribution and frictional Resistance in smooth rough Pipes – Roughness of Commercial Pipes – Moody's diagram |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>UNIT IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                 | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Compressible Fluid Flow – I: Thermodynamic basics – Equations of continuity, Momentum and Energy - Acoustic Velocity Derivation of Equation for Mach Number – Flow Regimes – Mach Angle – Mach Cone – Stagnation State Compressible Fluid Flow – II: Area Variation, Property Relationships in terms of Mach number, Nozzles, Diffusers – Fanno and Releigh Lines, Property Relations – Isothermal Flow in Long Ducts – Normal Compressible Shock, Oblique Shock: Expansion and Compressible Shocks – Supersonic Wave Drag                                                            |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

**Text Books:**

1. Yunus Cengel and John Cimbala, Fluid Mechanics, McGraw Hill Publishing Co. Ltd.
2. F M White, Viscous Fluid Flow, McGraw Hill Publishing Co. Ltd.
3. H Schlichting, Boundary Layer Theory, McGraw Hill Publishing Co. Ltd.
4. Fox, Pritchard and McDonald, Introduction to Fluid Mechanics, John Wiley & Sons

**Syllabus For PE5 and PE6 Elective Subjects**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |   |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
| ECE 501                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |   | REPAIR AND RETROFITTING OF STRUCTURES                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |   |
| Course category                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | : | Professional Elective-5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |   |
| Pre-requisite Subject                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | : | Design of concrete structures (BCE 303)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |   |
| Contact hours/week                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | : | Lecture: 3, Tutorial:1, Practical: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |   |
| Number of credits                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |   | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |   |
| Course Assessment methods                                                                                                                                                                                                                                                                                                                                                                                                                                                                | : | Continuous assessment through tutorials, attendance, home assignments, quizzes, record, One Minor test and One Major Theory Examination.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |   |
| Course Objectives                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |   | To learn about repair and retrofitting of concrete structures                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |   |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | : | The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course <ol style="list-style-type: none"><li>1. The importance of maintenance and assessment method of distressed structures.</li><li>2. The techniques for repair protection methods and understand the properties of repair materials Masonry repair &amp; retrofitting techniques</li><li>3. RC retrofitting; base isolation; damping; bridges; heritage structures</li><li>4. Repair, rehabilitation and retrofitting of structures and demolition methods.</li><li>5. the strength and durability properties, their effects due to climate and temperature.</li><li>6. recent development in concrete</li></ol> |   |
| Topics Covered                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |   |
| UNIT I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 9 |
| Maintenance, repair and rehabilitation, Facets of Maintenance, importance of Maintenance various aspects of Inspection, Assessment procedure for evaluating a damaged structure, causes of deterioration                                                                                                                                                                                                                                                                                 |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |   |
| UNIT II                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 9 |
| Special concretes and mortar, concrete chemicals, special elements for accelerated strength gain, Expansive cement, polymer concrete, Sulphur infiltrated concrete, ferro cement and polymers coating for rebars loadings from concrete, mortar and dry pack, vacuum concrete, Guniting and Shotcrete, Epoxy injection, Mortar repair for cracks, shoring and underpinning.<br>Methods of corrosion protection, corrosion inhibitors, corrosion resistant steels and cathodic protection |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |   |
| UNIT III                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 9 |
| Restoration and Retrofitting; Repair Materials; In-situ testing methods for RC and masonry structure; Techniques of repair and retrofitting of masonry buildings                                                                                                                                                                                                                                                                                                                         |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |   |
| UNIT IV                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 9 |
| Repair of structures distressed due to earthquake – Strengthening using FRP -Strengthening and stabilization techniques for repair, Engineered demolition techniques for structures -case studies.                                                                                                                                                                                                                                                                                       |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |   |
| Books & References:                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |   |
| 1. Concrete Structures, Materials, Maintenance and Repair- Denison Campbell, Allen and Harold Roper, (Longman Scientific and Technical, UK),1991                                                                                                                                                                                                                                                                                                                                         |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |   |

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| ECE 502                                                                                                                                                                                                                                                                                                                                                  | GEOTECHNICAL EARTHQUAKE ENGINEERING                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |   |
| Course category                                                                                                                                                                                                                                                                                                                                          | Professional Elective-5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |   |
| Pre-requisite subject                                                                                                                                                                                                                                                                                                                                    | Soil Mechanics (BCE 211)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |   |
| Contact hours/week                                                                                                                                                                                                                                                                                                                                       | Lecture: 3, Tutorial: 1, Practical: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |   |
| No. of credits                                                                                                                                                                                                                                                                                                                                           | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |   |
| Course assessment methods                                                                                                                                                                                                                                                                                                                                | Continuous assessment through attendance, home assignments, quizzes, record, viva voce and One Minor test and One Major Theory Examination                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |   |
| Course Objective                                                                                                                                                                                                                                                                                                                                         | To make the students able to develop an understanding of earthquake fundamentals, soil dynamics, seismic effects, and the seismic design of geotechnical structures using codal provisions.                                                                                                                                                                                                                                                                                                                                                                                                                           |   |
| Course outcomes                                                                                                                                                                                                                                                                                                                                          | The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course:<br>1. Explain earthquake mechanisms, seismic waves, and geotechnical zards.<br>2. Differentiate between earthquake magnitude (Richter scale) and intensity (Mercalli scale).<br>3. Evaluate liquefaction potential using simplified methods.<br>4. Identify key seismic hazards and site-specific mitigation techniques.<br>5. Analyse basic seismic design principles for geotechnical structures.<br>6. Interpret case studies of major earthquakes and their geotechnical impacts. |   |
| Topic covered                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |   |
| Unit I                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 9 |
| Fundamentals of earthquakes and seismicity, plate tectonics and fault mechanisms, seismic waves and wave propagation, earthquake magnitude and intensity scales, ground motion parameters (PGA, PGV, spectral acceleration), response spectra and design spectra, seismic zoning and hazard overview.                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |   |
| Unit II                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 9 |
| Cyclic behaviour of soils, dynamic stress–strain relationships, shear modulus and damping ratio, cyclic triaxial and resonant column tests, shear wave velocity measurements, ground response analysis, site amplification, local site effects and soil nonlinearity.                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |   |
| Unit III                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 9 |
| Deterministic seismic hazard analysis (DSHA), probabilistic seismic hazard analysis (PSHA), ground motion prediction equations, liquefaction mechanism and cyclic mobility, SPT-based liquefaction evaluation, CPT-based evaluation, shear wave velocity method, post-liquefaction settlement and lateral spreading, liquefaction mitigation techniques. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |   |
| Unit IV                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 9 |
| Seismic bearing capacity of shallow foundations, dynamic earth pressure on retaining structures, pile foundations under earthquake loading, pseudostatic slope stability analysis, Newmark sliding block method, seismic stability of earth dams and embankments, , ground improvement and seismic risk mitigation.                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |   |
| Text Books:                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |   |
| 1. Kramer, S.L. Geotechnical Earthquake Engineering (simplified chapters).<br>2. Geotechnical Applications for Earthquake Engineering" by T.G. Sitharam<br>3. Geotechnical Earthquake Engineering Handbook" by Robert W. Day                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |   |
| Reference:                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |   |
| 1. IS 1893 (Indian Standard for Earthquake-Resistant Design).                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |   |

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| <b>ECE 503</b>               | <b>ENVIRONMENTAL LAWS AND POLICY</b> |                                      |
| <b>Course category</b>       | :                                    | Professional Elective-5              |
| <b>Pre-requisite Subject</b> | :                                    | NIL                                  |
| <b>Contact hours/week</b>    | :                                    | Lecture: 3, Tutorial:1, Practical: 0 |
| <b>Number of credits</b>     | :                                    | 4                                    |

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| <b>Course Assessment methods</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | : | Continuous assessment through tutorials, attendance, home assignments, quizzes, record, One Minor test and One Major Theory Examination.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Course Objective</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |   | The main objective is to expand the student knowledge of the comprehensive understanding of environmental laws, policies, and management frameworks in India and globally.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Course Outcomes</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | : | <p>The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course</p> <ol style="list-style-type: none"> <li>1. To provide students with a comprehensive understanding of environmental laws, regulatory frameworks, and institutional mechanisms</li> <li>2. To enable students to critically analyse models of environmental management</li> <li>3. To develop student competency in environmental auditing, monitoring</li> <li>4. To able students analyse the sustainability assessment</li> <li>5. To foster awareness of the roles and responsibilities of government, NGOs, industries.</li> <li>6. To know about citizens in environmental protection</li> </ol> |
| <b>Topics Covered</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>UNIT I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Introduction to Environmental Law and Management Models: Evolution and scope of environmental laws in India and globally. Constitutional provisions related to environment (Article 48A, Article 51A (g)). Models of Environmental Management: Command-and- Control, Market-Based Instruments, Voluntary Approaches. The Precautionary Principle, Polluter Pays Principle, Public Trust Doctrine. Environmental Management Tools: EIA (Environmental Impact Assessment), EMS (Environmental Management Systems), Life Cycle Assessment (LCA). Introduction to the Environment Protection Act, 1986                                                                                                                                                         |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>UNIT II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Environmental Policies, Guidelines and Monitoring Mechanisms National Environmental Policy, 2006; Draft National Resource Efficiency Policy. Environmental guidelines and charters (CREP Guidelines, Corporate Environment Responsibility). Environmental auditing and environmental monitoring – types, procedures, and importance. Environmental reporting, economics, and green accounting. Concept of Extended Producer Responsibility (EPR). ESG (Environmental, Social, and Governance) reporting. ISO 14001: Environmental Management System Standards. Role of CPCB, SPCBs, and NGT (National Green Tribunal)                                                                                                                                      |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>UNIT III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Corporate Strategy, Incentives and Stakeholder Engagement. Theories of corporate strategy and environmental policy: Porter Hypothesis, Triple Bottom Line. Environmental incentives: subsidies, tax incentives, carbon credits, tradable permits. Local Economic Development and Environmental Management. Public-Private Partnership (PPP) in environmental governance. Corporate Social Responsibility (CSR) in environmental management. Case studies on successful industrial environmental practices. Environmental ethics and corporate accountability                                                                                                                                                                                               |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>UNIT IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Role of Government, NGOs, and Public Participation. Governmental role in environmental governance – regulatory, facilitative, enabling. Role of Non-Governmental Organizations (NGOs) in environmental awareness and activism. Citizen engagement and participatory governance in environmental policy. Policies beyond environmentalism: Urban development, energy, transportation, and agriculture. Sustainability issues: Climate justice, environmental equity, and intergenerational equity. Climate change policies and India's National Action Plan on Climate Change (NAPCC). Case laws and judicial activism (e.g., Ganga Pollution Case, Vellore Citizens' Welfare Forum Case). Green movements in India (e.g., Chipko, Narmada Bachao Andolan). |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

**Books & References:**

1. Divan, S. & Rosencranz, A. – Environmental Law and Policy in India, Oxford University Press
2. Leela krishnan, P. – Environmental Law in India, LexisNexis
3. Cullet, P. – Environmental Law and Policy in India, Routledge
4. UNEP Manuals – Environmental Management and Policies
5. Sahu, G.K. – Environmental Law, Himalaya Publishing House
6. World Bank Reports on environmental governance and local development

| ECE 504                                                                                                                                                                                                                                                                                                                                                                         |   | HIGHWAY GEOMETRIC DESIGN                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |   |
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| Course category                                                                                                                                                                                                                                                                                                                                                                 | : | Professional Elective-5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |   |
| Pre-requisite Subject                                                                                                                                                                                                                                                                                                                                                           | : | Highway Engineering (BCE 263)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |   |
| Contact hours/week                                                                                                                                                                                                                                                                                                                                                              | : | Lecture:3, Tutorial: 1, Practical:0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |   |
| Number of Credits                                                                                                                                                                                                                                                                                                                                                               | : | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |   |
| Course Assessment methods                                                                                                                                                                                                                                                                                                                                                       | : | Continuous assessment through tutorials, attendance, home assignments, quizzes, and One Minor test and One Major Theory Examination.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |   |
| Course Objectives                                                                                                                                                                                                                                                                                                                                                               | : | To introduce the fundamental factors influencing roadway planning and geometric design and develop the ability to design road sections, alignments, and infrastructure for diverse users and future improvements.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |   |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                 | : | The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course<br><div><div>1. Understand the key design factors to be considered before planning and designing road stretches.</div><div>2. Identify and describe the essential elements of a road section based on various types of road users.</div><div>3. Design the horizontal and vertical alignment profiles of roadways following standard guidelines.</div><div>4. Estimate the traffic handling capacity of roads and determine the need for upgradation.</div><div>5. Analyze and design safe and efficient layouts at road infrastructures.</div><div>6. Recognize and incorporate associated components essential to a complete road system.</div></div> |   |
| Topics Covered                                                                                                                                                                                                                                                                                                                                                                  |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |   |
| UNIT I                                                                                                                                                                                                                                                                                                                                                                          |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 9 |
| Introduction, Design factors, functional classification of roads and Space requirements, Cross-sectional elements – Profiles, Factors controlling, common elements, Specific elements (bicycle and pedestrian facilities, service roads), Road furniture – Longitudinal markings, Junction markings, Object markings, Messages, Road Traffic Signs, delineators, speed breakers |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |   |
| UNIT II                                                                                                                                                                                                                                                                                                                                                                         |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 9 |
| Sight distances – Stopping sight distance, Overtaking sight distance, Intermediate sight distance, Head light sight distance; Factors and sight distance under specific conditions                                                                                                                                                                                              |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |   |
| UNIT III                                                                                                                                                                                                                                                                                                                                                                        |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 9 |
| Highway Alignment – Types, Factors, surveys, Horizontal alignment – guiding principles, simple circular curve, Super elevation, Extra-widening, Transition curve, Gradients, Vertical curves – general guidelines and types; Alignment coordination and issues.                                                                                                                 |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |   |
| UNIT IV                                                                                                                                                                                                                                                                                                                                                                         |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 9 |

Truck Lay byes, Bus Rapid Transport stations and terminals; Toll Plaza layout design, Pedestrian over bridge and subway, Kilometer stone, Clearances and Access control

**Text books/ Reference books**

1. Khanna, S. K. and Justo, C. e. G., Manual for Highway testing manuals, Enchant Bros., Roorkee.
2. Kadiyali, L. R., Pr. and design of pavements, Khanna Publishers, New Delhi.
3. Das A and Chakraborty P, Principles of Transportation Engineering, PHI Pvt. Ltd. New Delhi
4. Wright, P. H., Highway Engineering, John Wiley and Sons, New York
5. Indian standards, ASTM Codes, IRC codes, MoRTH Specifications

| ECE 505                                                                                                                                                                                                                                                                                                                                                                                                                         |   | OPEN CHANNEL HYDRAULICS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Course category                                                                                                                                                                                                                                                                                                                                                                                                                 | : | Professional Elective-5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Pre-requisite Subject                                                                                                                                                                                                                                                                                                                                                                                                           | : | Hydraulics and Hydraulic Machine (BCE 261)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Contact hours/week                                                                                                                                                                                                                                                                                                                                                                                                              | : | Lecture : 3, Tutorial :1 , Practical: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Number of Credits                                                                                                                                                                                                                                                                                                                                                                                                               | : | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Course Assessment methods                                                                                                                                                                                                                                                                                                                                                                                                       | : | Continuous assessment through tutorials, attendance, home assignments, quizzes, viva voce, One Minor Test, and One Major Theory Examination                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Course Objectives                                                                                                                                                                                                                                                                                                                                                                                                               |   | To make the students understand and analyze free surface flow in open channels, including flow classification, depth computation, channel design, non-uniform flow, and hydraulic jump characteristics.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                                 | : | <p>The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course</p> <ol style="list-style-type: none"> <li>1. To explain the terms of the open channel flow equations and explain the interaction among the terms.</li> <li>2. To develop the open channel flow equations from the basic conservation equations.</li> <li>3. To solve open channel flow problems through the selection and use of appropriate equations.</li> <li>4. To explain the physical mechanisms and mathematical relationships for hydraulic jumps, surges, and critical, uniform, and gradually varying flows as well as spatially varied flow.</li> <li>5. Analysis and design of open channel controls, upstream and downstream controls, &amp; spatially varied flow.</li> <li>6. Analysis and design of open channel transition, functions, and energy dissipaters.</li> </ol> |
| <b>Topics Covered</b>                                                                                                                                                                                                                                                                                                                                                                                                           |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>UNIT I</b>                                                                                                                                                                                                                                                                                                                                                                                                                   |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Introduction: Basic concepts of free-surface flow, velocity and pressure distribution, Mass, energy, and momentum principle for prismatic and non-prismatic channels, Review of Uniform flow: Standard equations, hydraulically efficient channel sections, compound sections. Energy-depth relations: Concept of specific energy, specific force, critical flow, critical depth, hydraulic exponents, and channel transitions. |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>UNIT II</b>                                                                                                                                                                                                                                                                                                                                                                                                                  |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |



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| Gradually Varied Flow (GVF): Equation of gradually varied flow and its limitations, flow classification and surface profiles, Control sections, Computation methods and analysis, Integration of varied flow equation by analytical, graphical and advanced numerical methods, Transitions of subcritical and supercritical flow, flow in curved channels.                                                                                                                                                                                                                                                                                                    |          |
| <b>UNIT III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>9</b> |
| Rapidly Varied Flow (RVF): Characteristics of rapidly varied flow, Classical hydraulic jump, Evaluation of the jump elements in rectangular and non-rectangular channels on horizontal and sloping beds, Hydraulic jump in gradually and suddenly expanding channels, submerged hydraulic jump, rolling and sky jump, use of jump as an energy dissipater. Flow measurement: by sharp-crested and broad crested weirs, critical depth flumes, sluice gate, Free- overfall. Bold Rapidly varied unsteady flow: Equation of motion for unsteady flow, “Celerity” of the gravity wave, deep and shallow water waves, open channel - positive and negative surge. |          |
| <b>UNIT IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>9</b> |
| <b>Spatially Varied Flow (SVF):</b> Basic principles, Differential SVF equations for increasing and decreasing discharge, Classifications and solutions, Numerical methods for profile computation, Flow over side-weir and bottom-rack.                                                                                                                                                                                                                                                                                                                                                                                                                      |          |
| <b>Textbooks</b><br>1. Chow, V.T., Open channel Hydraulics, McGraw Hill International.<br><b>Reference Books</b><br>1. Henderson, F.M., Open Channel Flow, McGraw Hill International.<br>2. Subramanya, K., Flow in Open Channels, Tata McGraw Hill.<br>3. Ranga Raju, K.G., Flow through open channels, T.M.H.<br>4. M. Hanif Chaudhry, Open Channel Flow, PHI.<br>5. French, R.H., Open channel Hydraulics, McGraw Hill International.                                                                                                                                                                                                                      |          |

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| <b>ECE 506</b>                   | <b>GROUNDWATER HYDROLOGY</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Course Category</b>           | Professional Elective-5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Pre-requisite Subject</b>     | NIL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Contact hours/week</b>        | Lecture :3, Tutorial :1, Practical: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Number of credits</b>         | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Course assessment methods</b> | Continuous assessment through tutorials, attendance, home assignments, quizzes, One Minor test and One Major Theory Examination                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Course Objectives</b>         | To make the students understand the basic fundamentals of ground water flow and apply the knowledge of conjunctive use of ground water along with other fresh water sources                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Course Outcomes</b>           | The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course<br>1. Interpret groundwater field data, identify pollutants, saline water intrusion<br>2. Acquire preliminary knowledge in identifying the sources of groundwater<br>3. Apply knowledge of mathematics in deriving groundwater flow equations for steady and unsteady state<br>4. Comprehend the construction, working and development of wells in confined and unconfined aquifers<br>5. Understand the causes of groundwater pollution, modelling of contaminants in groundwater system and remedial measures for groundwater pollution<br>6. Create computer simulation models for groundwater systems |
| <b>Topics Covered</b>            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Unit I</b>                    | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

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| Introduction: Ground water utilization & historical background, ground water in hydrologic cycle, ground water budget, ground water level fluctuations & environmental influence, literature/ data/ internet resources Occurrence of groundwater: Origin & age of ground water, rock properties affecting groundwater, groundwater column, zones of aeration & saturation, aquifers and their characteristics/classification, groundwater basins & springs                                                                                    |          |
| <b>Unit II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>9</b> |
| Movement of ground water: Darcy's Law, permeability & its determination, Dupuit assumptions, heterogeneity & anisotropy, Ground water flow rates & flow directions, general flow equations through porous media; Advanced well hydraulics: steady/ unsteady, uniform/ radial flow to a well in a confined/ unconfined /leaky aquifer, well flow near aquifer boundaries/ for special conditions, partially penetrating/horizontal wells & multiple well systems, well completion/ development/ protection/ rehabilitation/ testing for yield. |          |
| <b>Unit III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>9</b> |
| Pollution and quality analysis of ground water: Municipal /industrial /agricultural /miscellaneous sources & causes of pollution, attenuation/ underground distribution / potential evaluation of pollution, physical /chemical /biological analysis of ground water quality, criteria & measures of ground water quality, ground water salinity & samples, graphical representations of ground water quality.                                                                                                                                |          |
| <b>Unit IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>9</b> |
| Modeling and management of ground water: Ground water modelling through porous media /analog / electric analog / digital computer models, ground water basin management concept, hydrologic equilibrium equation, ground water basin investigations, data collection & field work, dynamic equilibrium in natural aquifers, management potential & safe yield of aquifers, stream-aquifer interaction                                                                                                                                         |          |
| <b>Textbooks</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |          |
| 1. D.K. Todd and L. F. Mays, "Groundwater Hydrology", John Wiley and sons.<br>2. K. R. Karanth, "Hydrogeology", Tata McGraw Hill Publishing Company.<br>3. S. Ramakrishnan, "Ground water", S. Ramakrishnan.                                                                                                                                                                                                                                                                                                                                  |          |

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| ECE 601                   | STEEL STRUCTURES |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |   |
| Course category           | :                | Professional Elective-6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |   |
| Pre-requisite Subject     | :                | Structural Analysis (BCE 262)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |   |
| Contact hours/week        | :                | Lecture: 3, Tutorial: 1, Practical: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |   |
| Number of Credits         | :                | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |   |
| Course Assessment methods | :                | Continuous assessment through tutorials, attendance, home assignments, quizzes, record, One Minor Test and One Major Theory Examination.                                                                                                                                                                                                                                                                                                                                                                                                                                                                |   |
| Course Objectives         | :                | To make the students learn the designing of steel structure by analyzing axially loaded tension member, axially loaded column, design of lacing and batten system, design of slab base foundation.                                                                                                                                                                                                                                                                                                                                                                                                      |   |
| Course Outcomes           | :                | The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course<br>1. To know the basic properties of steel and to understand the behaviour according to it.<br>2. To know the different steel structure analysis and design.<br>3. To know the design and analysis of angle sections, bolted & welded connection.<br>4. Design of steel structures according to IS-800-2007 by limit state method.<br>5. To understand concepts of strength and stiffness considerations.<br>6. Analyze, and design the riveted and bolted connections. |   |
| Topics Covered            |                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |   |
| UNIT I                    |                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 9 |

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| Introduction: Properties of structural steel, rolled steel sections (ISMB, ISWB, ISA), and design philosophies (WSM vs. LSM).<br>Loads: Dead, live, wind, and seismic loads as per IS 875 and IS 1893.<br>Connections: Design of bolted and welded joints, including eccentric connections and prying action. |          |
| <b>UNIT II</b>                                                                                                                                                                                                                                                                                                | <b>9</b> |
| Tension Members: Failure modes (yielding, rupture, block shear), effective net area, and design of plates and angles.<br>Compression Members: Effective length, slenderness ratio, and design of axially loaded columns.<br>Built-up Columns: Design of laced and battened systems for compound sections.     |          |
| <b>UNIT III</b>                                                                                                                                                                                                                                                                                               | <b>9</b> |
| Beams: Design of laterally supported and unsupported beams, including checks for web buckling and web crippling.<br>Column Bases: Design of slab bases and gusseted bases for transferring loads to foundations.                                                                                              |          |
| <b>UNIT IV</b>                                                                                                                                                                                                                                                                                                | <b>9</b> |
| Roof Trusses: Selection of truss types, load calculation on purlins, and design of truss joints.<br>Plate Girders: Introduction to web and flange design, stiffeners, and splices.<br>Plastic Analysis: Concepts of plastic hinges, shape factors, and collapse mechanisms.                                   |          |
| <b>Textbooks:</b><br>1. Design of Steel Structures by N. Subramaniam, Oxford Publication<br>2. Design of Steel Structures by S. K. Duggal, Tata Mc-Graw-Hill Publishing Company                                                                                                                               |          |
| <b>Reference books:</b><br>1. Design of Steel Structures by A. S. Arya & J. L. Ajmani, Nem Chand & Bros., Roorkee.<br>Design of Steel Structures by Gaylord & Gaylord. 3. IS : 800 –2007                                                                                                                      |          |

| ECE 602                   |   | TUNNEL ENGINEERING                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
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| Course category           | : | Professional Elective-6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Pre-requisite Subject     | : | Soil Mechanics (BCE 211)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Contact hours/week        | : | Lecture : 3, Tutorial : 1, Practical: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Number of Credits         | : | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Course Assessment methods | : | Continuous assessment through tutorials, attendance, home assignments, quizzes, viva voce, One Minor Test, and One Major Theory Examination                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Course Objectives         | : | To make the students able to design the support system for tunnel by understanding the fundamental concepts of tunneling.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Course Outcomes           | : | The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course<br>1. Classify different types of tunnels and select appropriate tunnelling methods based on geological conditions.<br>2. Evaluate site investigation data and assess ground conditions for tunnel construction.<br>3. Design primary and secondary support systems for tunnels using analytical and empirical methods.<br>4. Compare and contrast different tunnelling methods and select optimal construction techniques<br>5. Assess ventilation, lighting, drainage, and safety considerations in tunnels.<br>6. Learn about conventional tunneling methods |
| <b>Topics Covered</b>     |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>UNIT I</b>             |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

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| Definition and purpose of tunnels, Historical development of tunnelling, Types of tunnels: Traffic tunnels, utility tunnels, mining tunnels, Classification based on purpose, location, and construction method, Tunnel geometry and cross-sectional shapes, Economic and environmental considerations, Case studies of major tunnel projects worldwide.                                                                                                                                                                         |          |
| <b>UNIT II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>9</b> |
| Geological factors affecting tunnel construction, Rock mass classification systems (RMR, Q-system, GSI), Groundwater conditions and hydrogeology, Site investigation methods: Drilling, geophysical surveys, Laboratory and field-testing procedures, Geological hazards: Squeezing ground, swelling rock, gas emissions, Interpretation of geological data for tunnel design.                                                                                                                                                   |          |
| <b>UNIT III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>9</b> |
| Design philosophy and load considerations, Ground-structure interaction principles, Primary support systems: Rock bolts, shotcrete, steel sets, Secondary support: Concrete lining design, Analytical methods: Ground reaction curves, convergence-confinement, Numerical modelling techniques, Design of portals and approaches, Waterproofing and drainage systems.                                                                                                                                                            |          |
| <b>UNIT IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>9</b> |
| Conventional tunnelling methods: NATM, Cut and Cover, Mechanized tunnelling: TBM types and selection criteria, Shield tunnelling and EPB machines, Drill and blast techniques, Ground improvement methods, Construction sequence and cycle optimization, Quality control and construction monitoring, Special construction techniques for difficult ground. Tunnel lighting and ventilation systems, Fire safety, emergency systems, and escape routes, Tunnel collapses and case studies, Environmental impacts and mitigation. |          |
| <b>Text Books:</b><br>1. Tunnel Engineering Handbook, Thomas R. Kuesel, Elwyn H. King, and John O. Bickel (2nd Edition, Chapman & Hall/CRC, 2012)<br>2. Tunnelling and Tunnel Mechanics, Dimitrios Kolymbas<br>3. Rock Mechanics and Engineering, Xia-Ting Feng (CRC Press, 2017)                                                                                                                                                                                                                                                |          |
| <b>References:</b><br>1. Modern Tunnelling Science and Technology, Bernard Maidl<br>2. Tunnelling: Planning, Design, Construction, B. Singh & A.K. Goel<br>3. IS Code: IS 5878 (Parts I-VI), Indian Standards for Tunnelling                                                                                                                                                                                                                                                                                                     |          |

| ECE 603                          |   | ANALYSIS AND DESIGN OF WATER DISTRIBUTION SYSTEMS                                                                                                                                                              |
|----------------------------------|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course category</b>           | : | Professional Elective-6                                                                                                                                                                                        |
| <b>Pre-requisite Subject</b>     | : | Water and Wastewater Engineering (BCE 302)                                                                                                                                                                     |
| <b>Contact hours/week</b>        | : | Lecture :3, Tutorial :1 , Practical: 0                                                                                                                                                                         |
| <b>Number of Credits</b>         | : | 4                                                                                                                                                                                                              |
| <b>Course Assessment methods</b> | : | Continuous assessment through tutorials, attendance, home assignments, quizzes, viva voce, One Minor Test, and One Major Theory Examination                                                                    |
| <b>Course Objectives</b>         | : | To provide a thorough theoretical and practical knowledge in water distribution systems using which a student can solve real world problems concerning with design and analysis of pipe network distributions. |

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| <b>Course Outcomes</b>                                                                                                                                                                                                                                                                                                                                                                                                                             | : | <p>The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course</p> <ol style="list-style-type: none"> <li>1. Develop water distribution systems with a thorough understanding of hydraulic principles and system components.</li> <li>2. Perform calculations and solve problems commonly encountered in water distribution systems, such as volumes, flow rates, velocities, pressures, and chemical dosage</li> <li>3. Evaluate existing systems to identify inefficiencies and implement effective solutions.</li> <li>4. Apply industry-standard design standards to create efficient and reliable water distribution networks.</li> <li>5. Use EPANET2 software to model, analyze, and optimize water distribution systems.</li> <li>6. Design comprehensive water systems at the sub-division level, addressing both hydraulic and quality considerations.</li> </ol> |
| <b>Topics Covered</b>                                                                                                                                                                                                                                                                                                                                                                                                                              |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>UNIT I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                      |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Introduction to pipe networks: Types of networks: serial, branching, and looped; parameters; labelling network elements: branching and looped networks; parameters interrelationships: pipe head loss relationship, node flow continuity relationship, loop head loss relationship; rules for solvability of pipe networks: rules proposed by Shamir and Howard; rules proposed by Goffman and Rodeh; rules proposed by Bhawe; comparison of rules |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>UNIT II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                     |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Formulation of equations: states of parameters; basic unknown parameters; single source and multi-source networks with known pipe resistances: branching and looped networks; networks with unknown pipe resistances: branched and looped; inclusion of pumps: supply and booster; inclusion of check valves: in an external pipe, in an internal pipe, in several pipes; inclusion of pressure reducing valves                                    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>UNIT III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                    |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Hardy-Cross Method: Method of balancing heads; method of balancing flows; modified Hardy-Cross method; selection of initial values; convergence problems Newton-Raphson Method: Basic concepts; head equations; loop equations; labelling network elements Linear theory method: pipe discharge equations; nodal head equations; relationship between Newton-Raphson and linear theory method                                                      |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>UNIT IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                     |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Dynamic Analysis: Iterative method; direct method. Node flow analysis: two node serial network; node classification; NFA theory. Calibration: data collection and preparation; calibration methods; practical considerations                                                                                                                                                                                                                       |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Textbooks</b> <ol style="list-style-type: none"> <li>1. Pramod R Bhawe, Analysis of flow in water distribution networks, Technomic Publications, 2004.</li> <li>2. Lewis A Rossman, EPANET 2 User Manual, 2000</li> </ol>                                                                                                                                                                                                                       |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

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| <b>ECE 604</b>               | <b>URBAN TRANSPORTATION SYSTEM PLANNING</b> |                                    |
| <b>Course category</b>       | :                                           | Professional Elective-6            |
| <b>Pre-requisite Subject</b> | :                                           | Highway Engineering (BCE 263)      |
| <b>Contact hours/week</b>    | :                                           | Lecture:3, Tutorial:1, Practical:0 |
| <b>Number of Credits</b>     | :                                           | 4                                  |

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| <b>Course methods</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>Assessment</b> | : | Continuous assessment through tutorials, attendance, home assignments, quizzes, record, viva voce and One Minor Test and One Major Theory Examination                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Course Objectives</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                   | : | To make the students familiar with the techniques of urban transportation system by analyzing traffic flow and assigning traffic to appropriate transportation network.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Course Outcomes</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                   | : | <p>The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course</p> <ol style="list-style-type: none"> <li>1. Analyze urban traffic movement characteristics and estimate traffic demand using appropriate demand functions.</li> <li>2. Develop traffic analysis zones and formulate trip generation models using statistical and analytical methods.</li> <li>3. Apply various trip distribution models (e.g., growth factor and gravity models) to estimate inter-zonal travel patterns.</li> <li>4. Evaluate mode choice behavior using competing and probabilistic modal split models.</li> <li>5. Perform traffic assignment using route split analysis and transportation network elements to determine traffic flow patterns.</li> <li>6. Apply traffic assignment techniques in transportation networks.</li> </ol> |
| <b>Topics Covered</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                   |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>UNIT I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                   |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Transportation planning process and concepts: Role of Transportation, Transportation Problems, Urban Travel Characteristics, Concept of Travel Demand, Demand Function, Demand Estimation.                                                                                                                                                                                                                                                                                                                                                                                  |                   |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>UNIT II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                   |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Trip Generation Analysis: Zoning, Types and Sources of Data, Expansion Factors, Accuracy Checks, Trip Generation Models (Zonal Models, Household Models, Category Analysis, Trip Attraction of Work Centers). Trip Distribution Analysis: Trip Distribution Models, Growth Factor Models, Gravity Models, Opportunity Models.                                                                                                                                                                                                                                               |                   |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>UNIT III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                   |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Model Split Analysis: Model Split Models, Mode Choice Behavior, Competing Models, Mode Split Curves, Probabilistic Models.                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                   |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>UNIT IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                   |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Traffic Assignment: Route Split Analysis, Elements of Transportation Networks, Nodes and Links, Minimum Path Trees, All-or-nothing Assignment, Multiple Assignment, Capacity Restraint                                                                                                                                                                                                                                                                                                                                                                                      |                   |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Textbooks</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                   |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <ol style="list-style-type: none"> <li>5. Kadiyali, L. R., "Traffic engineering and transport planning", 6th edition, Khanna publishers</li> <li>6. Khisty C. J and Lall B. K., Transportation Engineering, Prentice Hall of India</li> </ol>                                                                                                                                                                                                                                                                                                                               |                   |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Reference books</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                   |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <ol style="list-style-type: none"> <li>1. Papacostas, C. S., Fundamentals of Transportation Engineering, Prentice Hall of India, New Delhi</li> <li>2. Prakash Rao and Sundaram, Regional Development Planning in India, Vikas Publishing House.</li> <li>3. B.G. Hutchinson, Introduction to Urban Transportation Systems Planning, McGraw Hill. Vukan R. Vuchic, Urban Public Transportation Systems and Technology, Prentice Hall Inc., N.J.</li> <li>4. G.E. Gray and L.A. Hoel, Public Transportation Planning Operations and Management, Prentice Hall Inc</li> </ol> |                   |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

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|------------------------|----------------------------------------------------|-------------------------|--|
| <b>ECE 605</b>         | <b>ANALYSIS AND DESIGN OF HYDRAULIC STRUCTURES</b> |                         |  |
| <b>Course category</b> | :                                                  | Professional Elective-6 |  |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Pre-requisite Subject</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | : | Hydraulics and Hydraulic Machine (BCE 261)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Contact hours/week</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | : | Lecture : 3, Tutorial : 1 , Practical: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Number of Credits</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | : | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Course Assessment methods</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | : | Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce and One Minor Test and One Major Theory Examination.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Course Objective</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |   | To provide a thorough theoretical and practical knowledge in water management systems using which a student can solve real world problems concerning with river training, gravity and embankment dams and flood routing.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Course Outcomes</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |   | <p>The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course</p> <ol style="list-style-type: none"> <li>1. Use and integrate the fundamental and basic studies towards the goal of selecting, analysing, and designing of hydraulic structures.</li> <li>2. Cope with decision-making and satisfy competing objectives.</li> <li>3. Design, analyse and prove that the hydraulic structures are safe and economical.</li> <li>4. Work in a team and learn successful group interaction for a project.</li> <li>5. Deliver an oral presentation for the project.</li> <li>6. Perform studies of various hydraulic structures such as weir/barrages and cross-drainage works.</li> </ol> |
| <b>Topics Covered</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>UNIT I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Types of Headworks: Component parts of a diversion headwork, Failure of hydraulic structures founded on permeable foundations, principles of design; Bligh's theory, Khosla's theory for determination of pressure and exit gradient. Design and drawing of weir and barrages. Regulation Works Falls, Classification, Introduction to design principle of falls, Design and drawing of Sarda type and straight glacis fall. Principle and design & drawing of Distributary head- regulator and cross-regulator, canal escape, Bed bars. |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>UNIT II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Canal Headworks: Functions, Location, Layout of headworks. Weir and Barrage, Canal head regulator, Introduction to the design principles of Weirs and barrages on permeable foundations, Design of vertical drop and sloping glacis weir and barrage.<br>Cross Drainage works: Necessity and types. Aqueduct, Siphon Aqueduct, siphon passage, canal siphon, level crossing, Introduction to design principles and design and drawing of cross-drainage works.                                                                           |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>UNIT III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Flood routing: Types, methods of reservoir routing, channel routing by Muskingham Method. Investigation and planning of dams and Reservoirs: Zones of storage, Estimation of storage capacity, Reservoir losses, Reservoir sedimentation, and its control, the life of a reservoir.<br>Dams: classification and selection criteria. Earth Dams: Classification, causes of failure Phreatic line, and its determination Introduction to stability analysis.                                                                               |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>UNIT IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| stability analysis, galleries, joints, control of cracks. Spillways: Spillway capacity, types of spillways, Design of ogee spillway, Energy dissipation below the spillway, Design criteria for Hydraulic Jump type stilling basins with horizontal and sloping aprons, design principles of different types of spillway gates.                                                                                                                                                                                                          |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Textbooks</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 1. Water Resources Engg. - Larry W Mays, John Wiley India                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

2. Water resources Engg. - Wurbs and James, John Wiley India
3. Water Resources Engg. - R.K. Linsley, McGraw Hill 29
4. Irrigation and Water Resources Engg. - G L Asawa, New age International Publishers

**Reference Books**

1. Irrigation Engg. And Hydraulic Structures - S. K. Garg, Khanna Publishers
2. Irrigation and Water Power Engineering- B. C. Punamia & Pande B.B. Lal

**Syllabus For PE7, PE8 and PE9 Elective Subjects**

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|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
| ECE 701                                                                                                                                                                                                                                                                                                                                                                                |   | ADVANCE CONCRETE TECHNOLOGY                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |   |
| Course category                                                                                                                                                                                                                                                                                                                                                                        | : | Professional Elective – 7                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |   |
| Pre-requisite Subject                                                                                                                                                                                                                                                                                                                                                                  | : | NIL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |   |
| Contact hours/week                                                                                                                                                                                                                                                                                                                                                                     | : | Lecture: 3, Tutorial:1, Practical: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |   |
| Number of credits                                                                                                                                                                                                                                                                                                                                                                      | : | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |   |
| Course Assessment methods                                                                                                                                                                                                                                                                                                                                                              | : | Continuous assessment through tutorials, attendance, home assignments, quizzes and One Minor test and One Major examination.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |   |
| Course Objective                                                                                                                                                                                                                                                                                                                                                                       | : | To provide students necessary skills and modern advancement in concrete technology.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |   |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                        | : | <p>The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course</p> <ol style="list-style-type: none"><li>1. Able to understand the test results of all the constituents of concrete materials and design the concrete mix using IS code method.</li><li>2. Able to determine the properties of fresh and hardened of concrete design special concretes and their specific applications ensure quality control while testing/ sampling and acceptance criteria.</li><li>3. Understand limit state design philosophy.</li><li>4. Understand the behavior of beam under flexure and shear.</li><li>5. Able to design beams using limit state method.</li><li>6. Able to design one way slab using limit state method.</li></ol> |   |
| Topics Covered                                                                                                                                                                                                                                                                                                                                                                         |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |   |
| UNIT I                                                                                                                                                                                                                                                                                                                                                                                 |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 9 |
| Constituent of concrete, grade of concrete, manufacturing of concrete, importance of water cement ratio, properties of fresh concrete workability, factor affecting workability, consistency, cohesiveness, bleeding, segregation Properties of hard concrete, compressive, tensile and flexure strength, modulus of elasticity, shrinkage and creep.                                  |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |   |
| UNIT II                                                                                                                                                                                                                                                                                                                                                                                |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 9 |
| Mix design for compressive strength by various methods, mix design for flexural strength, Admixtures used in cement concrete. Introduction to Various Design Philosophies, Design of Rectangular Singly and Doubly Reinforced Sections by Working Stress Method. Assumptions in Limit State Design Method, Design of Rectangular Singly and Doubly Reinforced beams, T-beams, L-beams. |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |   |
| UNIT III                                                                                                                                                                                                                                                                                                                                                                               |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 9 |
| Behavior of RC beams in Shear, Shear Strength of beams with and without shear reinforcement, Minimum and Maximum shear reinforcement. Introduction to development length, Anchorage bond, flexural bond, Failure of beam under shear.                                                                                                                                                  |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |   |
| UNIT IV                                                                                                                                                                                                                                                                                                                                                                                |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 9 |



Design of one way and two-way slabs. Serviceability Limit States, Control of deflection, cracking and vibrations. Design of Columns by Limit State Design Method. Effective height of columns, Minimum eccentricity, column under axial compression, requirements for reinforcement, Column with helical reinforcement.

#### **Textbooks**

1. IS : 456 – 2000.
2. Reinforced Concrete – Limit State Design by A. K. Jain, Nem Chand & Bros., Roorkee.

#### **Reference books**

1. Plain and Reinforced Concrete Vol. I & II by O. P. Jain & Jai Krishna, Nem Chand & Bros.
2. Reinforced Concrete Structures by R. Park and Pauley.
3. Reinforced Concrete Design by P. Dayaratnam.

| <b>ECE 702</b>                                                                                                                                                                                                                                                                                                                                                                                       |   | <b>EARTH AND EARTH RETAINING STRUCTURES</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course category</b>                                                                                                                                                                                                                                                                                                                                                                               | : | Professional Elective – 7                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Pre-requisite Subject</b>                                                                                                                                                                                                                                                                                                                                                                         | : | Foundation Engineering (BCE 301)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Contact hours/week</b>                                                                                                                                                                                                                                                                                                                                                                            | : | Lecture: 3, Tutorial:1, Practical: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Number of credits</b>                                                                                                                                                                                                                                                                                                                                                                             | : | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Course Assessment methods</b>                                                                                                                                                                                                                                                                                                                                                                     | : | Continuous assessment through tutorials, attendance, home assignments, quizzes and One Minor test and One Major examination                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Course Objective</b>                                                                                                                                                                                                                                                                                                                                                                              | : | To make students understand the principles, analysis, design, and construction aspects of ground improvement techniques and earth-retaining structures for safe and efficient geotechnical engineering applications.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Course Outcomes</b>                                                                                                                                                                                                                                                                                                                                                                               | : | The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course: <ol style="list-style-type: none"> <li>1. Explain the concepts and design considerations involved in overexcavation and replacement methods, including settlement and bearing capacity behaviour.</li> <li>2. Apply principles of in situ ground reinforcement such as ground anchors and soil nailing for improving slope and retaining system stability.</li> <li>3. Classify and select suitable retaining structures based on soil conditions, loading, and construction requirements.</li> <li>4. Analyze different types of gravity, embedded, and composite retaining walls considering structural and geotechnical performance.</li> <li>5. Evaluate factors affecting earth pressure and assess wall–soil interaction under static and seismic loading conditions.</li> <li>6. Design retaining systems incorporating stability analysis, drainage provisions, and practical construction considerations.</li> </ol> |
| <b>Topics Covered</b>                                                                                                                                                                                                                                                                                                                                                                                |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>UNIT I</b>                                                                                                                                                                                                                                                                                                                                                                                        |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Over excavation and replacement: Stress distribution and failure modes, general shear and punching failures, failure of distributed foundations, minimum bearing capacity and factor of safety, settlement of footings on layered soils and replaced zones. Construction aspects including selection of fill material, excavation, placement and compaction, and quality control covering locations. |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>UNIT II</b>                                                                                                                                                                                                                                                                                                                                                                                       |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

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| Ground reinforcement: Ground anchors and soil nailing, principles, design considerations & procedures, construction methods, design recommendations, global stability considerations, nail–soil pull-out failure, factors of safety and composite support systems.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |          |
| <b>UNIT III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>9</b> |
| Classification of retaining structures, gravity walls including mass concrete, gabions, crib, interlocking block, masonry, semi-gravity concrete, reinforced concrete cantilever, counterfort, and buttressed walls. Embedded wall systems, sheet pile walls, bored pile walls, diaphragm walls, king post or soldier pile walls, and jet-grouted walls.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |          |
| <b>UNIT IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>9</b> |
| Fundamentals of earth-retaining systems, selection & design criteria, modes of failure, factors affecting earth pressure, wall and ground movements, wall flexibility and required movements for active and passive states, external loading effects, compaction pressures, swelling, shrinkage, and thermal effects. Stability of retaining walls under seismic loading, embedded wall design considerations.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |          |
| <b>Books and references:</b> <ol style="list-style-type: none"> <li>1. Clayton, C.R.I., Woods, R.I., Bond, A.J., and Milititsky, J. Earth Pressure and Earth-Retaining Structures, Third Edition, CRC Press, Taylor &amp; Francis Group.</li> <li>2. Han, J. Principles and Practice of Ground Improvement, Wiley, 2015.</li> <li>3. Almeida, M. and Marques, M.E.S. (2013) Design and Performance of Embankments on Very Soft Soils, CEC Press, London, U.K.</li> <li>4. Hausmann, M.R. (1976) Engineering principles of ground modification, McGraw-Hill Publishing Co., New York, N.Y. USA.</li> <li>5. Kempfert, H.G. and Gebreselassie, B. (2006) Excavations and Foundations in Soft Soils, Springer, The Netherlands.</li> <li>6. Koerner, R.M. (2012) Designing with Geosynthetics. Vols. 1&amp;2, 6th Edition, Xlibris Corporation, USA.</li> <li>7. Jewell, R.A. (1996) Soil reinforcement with geotextiles, CIRIA &amp; Thomas Telford, London, U.K.</li> <li>8. John, N.W.M. (1987) Geotextiles, Blackie &amp; Son Ltd., London, U.K.</li> <li>9. Jones, C.J.F.P. (2010) Earth Reinforcement and Soil Structures, Thomas Telford, London, U.K.</li> <li>10. Saran, Swami (2006) Reinforced Soil and its Engineering Applications, I.K. International, New Delhi.</li> <li>11. Shukla, S.K. (2012) Handbook of Geosynthetic Engineering, 2nd Edition, ICE Publishing, London, U.K.</li> </ol> |          |

| <b>ECE 703</b>                   | <b>ENVIRONMENTAL CHANGE AND SUSTAINABLE DEVELOPMENT</b> |                                                                                                                                                                                                                                                                                               |
|----------------------------------|---------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course category</b>           | :                                                       | Professional Elective – 7                                                                                                                                                                                                                                                                     |
| <b>Pre-requisite Subject</b>     | :                                                       | NIL                                                                                                                                                                                                                                                                                           |
| <b>Contact hours/week</b>        | :                                                       | Lecture: 3, Tutorial:1, Practical: 0                                                                                                                                                                                                                                                          |
| <b>Number of credits</b>         | :                                                       | 4                                                                                                                                                                                                                                                                                             |
| <b>Course Assessment methods</b> | :                                                       | Continuous assessment through tutorials, attendance, home assignments, quizzes and One Minor test and One Major examination.                                                                                                                                                                  |
| <b>Course Objective</b>          | :                                                       | The main objective is to expand the student knowledge of the sustainability, environmental change, and development challenges through global frameworks like the SDGs, systems thinking, and engineering tools.                                                                               |
| <b>Course Outcomes</b>           | :                                                       | <p>The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course</p> <ol style="list-style-type: none"> <li>1. To introduce students to the key concepts, challenges, and debates related to environmental change</li> </ol> |

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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <ol style="list-style-type: none"> <li>2. To develop an understanding of sustainability indicators, systems thinking, and the inter linkages among ecological</li> <li>3. To understand the students about the SDGs goals.</li> <li>4. To equip students with engineering tools and frameworks such as life cycle assessment</li> <li>5. To promote critical thinking on the relevance of traditional knowledge, community- based practices</li> <li>6. To understand about the traditional approaches to sustainability.</li> </ol> |
| <b>Topics Covered</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>UNIT I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Foundations of Sustainability and Environmental Change. Introduction to sustainability and sustainable development. Key issues: food security, material consumption, energy resources, and ecological footprint. Ethical dimensions of sustainability: intergenerational equity, environmental justice, planetary boundaries. Global and local resource demands – current trends and future projections. Paradigms of environmental change: from agricultural age to industrial and post-industrial age. Concept of circular economy and resource efficiency. Environmental Kuznets Curve                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>UNIT II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Population, Growth Limits, and Sustainability Debates. Population growth and resource use: Malthusian theory, Demographic Transition. Limits to Growth (Club of Rome Report) – critical review and current relevance. Carrying capacity and ecological resilience. Current debates in sustainability: green growth vs. degrowth, techno-optimism vs. ecological realism. Environmental movements and grassroots sustainability initiatives. Climate change and sustainability linkages. Role of education and communication in sustainability transitions.                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>UNIT III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Sustainable Development Goals (SDGs) and Systems Thinking. United Nations Sustainable Development Goals (SDGs): Overview and India's progress. Relationships between ecological, economic, and social systems – the "Triple Bottom Line". System dynamics for sustainability assessment. Environmental and social indicators of sustainability (HDI, Ecological Footprint, GPI, etc.). Environmental justice and gender in sustainable development. National missions aligned with SDGs (e.g., National Solar Mission, Swachh Bharat Abhiyan).                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>UNIT IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Engineering and Traditional Approaches to Sustainability. Engineering tools for sustainability: EIA, LCA, carbon footprint analysis, green design. Sustainable engineering practices in energy, water, and construction sectors. Role and relevance of traditional ecological knowledge (TEK) and rural development paradigms. Community-based natural resource management (CBNRM) and participatory approaches. Bioeconomy, green infrastructure, and nature-based solutions. Smart villages and sustainable rural infrastructure in India.                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Textbooks/ Reference books</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <ol style="list-style-type: none"> <li>1. Kates, R. W., Parris, T. M., &amp; Leiserowitz, A. A. – What is Sustainable Development? Goals, Indicators, Values, and Practice</li> <li>2. Meadows, D.H., Meadows, D.L., &amp; Randers, J. – Limits to Growth</li> <li>3. Mebratu, D. – Sustainability and Sustainable Development: Historical and Conceptual Review, Environmental Impact Assessment Review</li> <li>4. Margerum, R. – Beyond Consensus: Improving Collaborative Planning and Management</li> <li>5. MoEF&amp;CC, NITI Aayog, Government of India – Reports on SDGs and sustainability</li> <li>6. UNDP – Human Development Reports</li> <li>7. World Bank – Reports on climate change and sustainability</li> <li>8. CPCB – Guidelines on sustainable development practices in India Chopra, K., and Kadakodi, G.K., Operationalising Sustainable Development, Sage Publication, New Delhi, 1999.</li> </ol> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

|                                                                                                                                                                                                                                                                                                                                                                                                                              |                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>ECE 704</b>                                                                                                                                                                                                                                                                                                                                                                                                               | <b>INTELLIGENT TRANSPORTATION SYSTEM</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Course category</b>                                                                                                                                                                                                                                                                                                                                                                                                       | :                                        | Professional Elective – 7                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Pre-requisite Subject</b>                                                                                                                                                                                                                                                                                                                                                                                                 | :                                        | NIL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Contact hours/week</b>                                                                                                                                                                                                                                                                                                                                                                                                    | :                                        | Lecture: 3, Tutorial:1, Practical: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Number of credits</b>                                                                                                                                                                                                                                                                                                                                                                                                     | :                                        | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Course Assessment methods</b>                                                                                                                                                                                                                                                                                                                                                                                             | :                                        | Continuous assessment through tutorials, attendance, home assignments, quizzes and One Minor test and One Major examination.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Course Objective</b>                                                                                                                                                                                                                                                                                                                                                                                                      | :                                        | To make the students understands the concept of Intelligent Transportation Systems (ITS) and their application to solve the problem of modern urban transportation system.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Course Outcomes</b>                                                                                                                                                                                                                                                                                                                                                                                                       | :                                        | The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course:<br>1. Understand the fundamentals and objectives of Intelligent Transportation Systems (ITS) and its evolution.<br>2. Explain various data collection techniques used in ITS including detectors, AVL, AVI, GIS, and video analytics.<br>3. Demonstrate the role and functioning of telecommunication systems within ITS infrastructure.<br>4. Identify and describe the major functional areas of ITS<br>5. Analyze ITS user needs and service domains such as traffic, transit, payment, safety, and emergency management.<br>6. Evaluate the integration of information and communication technologies for efficient traffic and transportation management. |
| <b>Topics Covered</b>                                                                                                                                                                                                                                                                                                                                                                                                        |                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>UNIT I</b>                                                                                                                                                                                                                                                                                                                                                                                                                |                                          | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Introduction to Intelligent Transportation Systems (ITS): Definition of its and Identification of its Objectives, Historical Background, Benefits of ITS, its Collection Techniques - Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), Geographic Information System (GIS), Video Data Collection                                                                                        |                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>UNIT II</b>                                                                                                                                                                                                                                                                                                                                                                                                               |                                          | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Telecommunication in ITS: Importance of Telecommunications in the its System, Information Management, Traffic Management Centres (TMC), Vehicle - Road Side Communication, Vehicle Positioning System                                                                                                                                                                                                                        |                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>UNIT III</b>                                                                                                                                                                                                                                                                                                                                                                                                              |                                          | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| ITS Functional Areas: Advanced Traffic Management System (ATMS), Advanced Traveller Information Systems (ATIS), Commercial Vehicle Operations (CVO), Advanced Vehicle Control System (AVCS), Advanced Public Transportation System (APTS), Advance Rural Transportation Systems (ARTS)                                                                                                                                       |                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>UNIT IV</b>                                                                                                                                                                                                                                                                                                                                                                                                               |                                          | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| ITS User Needs and Services: Travel and Traffic Management, Public Transportation Management, Electronic Payment, Commercial Vehicle Operations, Emergency Management, Advanced Vehicle Safety Systems, Information Management                                                                                                                                                                                               |                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Reference Books:</b>                                                                                                                                                                                                                                                                                                                                                                                                      |                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 1. Sussman, J.M., Perspective on ITS, Artech House Publications, 2005<br>2. ITS Hand book 2000: Recommendations for world road association (PIARC) by Kan Paul Chen, John Miles<br>3. Chen, Kan and John C. Miles, ed. ITS Handbook 2000: Recommendations from the World Road Association (PIARC). Artech House Inc, Boston, 1999. 2.<br>4. McQueen, Bob, Rick Schuman, and Kan Chen. Advanced Traveler Information Systems, |                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

- Artech House Inc., Boston, 2002.
5. Ozbay, Kaan, and Pushkin Kachroo. Incident Management in Intelligent Transportation Systems, Artech House, Boston.

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| ECE 705                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |   | WATER RESOURCES MANAGEMENT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |   |
| Course category                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | : | Professional Elective – 7                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |   |
| Pre-requisite Subject                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | : | NIL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |   |
| Contact hours/week                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | : | Lecture: 3, Tutorial:1, Practical: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |   |
| Number of credits                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |   | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |   |
| Course Assessment methods                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | : | Continuous assessment through tutorials, attendance, home assignments, quizzes and One Minor test and One Major examination.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |   |
| Course Objective                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | : | To make the students understands the basic principles of water resources and its planning and management.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |   |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | : | The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course:<br>1. Understand the planning of water resources and need for water resource management.<br>2. Understand the water resource potential in global, India scenario and explore the water resources using different technologies.<br>3. Acquire a knowledge international and national water law and its policy.<br>4. Explain the concept of water in agricultural and economic aspects.<br>5. Predict the future trends of water demand and its management during crisis<br>6. Be aware of various national and international laws associated with water usage |   |
| Topics Covered                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |   |
| UNIT I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 9 |
| Water, A Multi-Dimensional Resource: Water resources planning- multi-dimensional management- Water withdrawal and consumption by sector-Stress, international policy- Climate change, oceans, challenges and need for water resource management Global and Indian Scenario for Water Resources: Surface Water and Groundwater Global and Indian Scenario-Quality of water resources Water use and sustainable reuse methods- Usable water resources by continent and country-Water footprint. |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |   |
| UNIT II                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 9 |
| Water Resources Assessment: Network design-Stream flow gauging-Weir design-Gauges- Current gauging-Salt dilution Geophysical Exploration-Test drilling-Application of remote sensing techniques Water in Agricultural Systems: Water for food production, virtual water trade for achieving global water security, irrigation efficiencies, irrigation methods and current water pricing, water for livestock and processing, water pollution from agricultural production                    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |   |
| UNIT III                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 9 |
| Water Economics: Economic characteristics of water good and services-Nonmarket monetary valuation methods-Water economic instruments-Policy options for water conservation and sustainable use, pricing, distinction between values and charges-Private sector involvement in water resources management.                                                                                                                                                                                     |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |   |
| UNIT IV                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 9 |
| Water Legal and Regulatory Settings: National and International Framework for Water Law; Basic structure of water law- An overview of water law in India -Evolution of water law, key features of water law, evolving water law and policy-Water policy for Irrigation, decentralization and participation in                                                                                                                                                                                 |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |   |

irrigation management, and the policy measures proposed to establish water user associations. National level initiatives for regulation of groundwater, State groundwater laws and rainwater harvesting.

#### Textbooks

1. David Stephenson, Water Resources Management, 2004, A. A. Balkema Publishers, Netherlands.
2. Louis Theodore, Ryan Dupont R., Water Resource Management Issues, Basic Principles and Applications, 2020, CRC Press, Taylor & Francis Group, New York.
3. Philippe Cullet and Sujith Koonan, Water Law in India- An Introduction to Legal Instruments, 2017. Second Edition, Oxford University Press, New Delhi.
4. Subramanya. K., Engineering Hydrology, 2020, Fifth Edition, McGraw Hill Education Pvt. Ltd., New Delhi.

| ECE 706                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |   | APPLICATION OF MACHINE LEARNING IN CIVIL ENGINEERING                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |   |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
| Course category                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | : | Professional Elective – 7                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |   |
| Pre-requisite Subject                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | : | NIL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |   |
| Contact hours/week                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | : | Lecture : 3, Tutorial :1, Practical: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |   |
| Number of Credits                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | : | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |   |
| Course Assessment methods                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | : | Continuous assessment through tutorials, attendance, home assignments, quizzes, viva voce, One Minor Test, and One Major Theory Examination                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |   |
| Course Objective                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | : | To make the students understand the concepts and techniques of AI-ML and explore their applications in civil engineering.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |   |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | : | The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course:<br><div><div>1. Identify the basics of Artificial Intelligence and Machine Learning.</div><div>2. Indicate how AI and ML can improve different activities in civil engineering.</div><div>3. Apply AI and ML algorithms to solve problems in civil engineering.</div><div>4. Develop skills to apply AI and ML algorithms for solving problems in civil engineering.</div><div>5. Applications of AI to construction management problems</div><div>6. Knowledge about ethical considerations in AI and ML applications</div></div> |   |
| Topics Covered                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |   |
| UNIT I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 9 |
| Introduction to AI and ML: 1.1 Scope of the Course, Introduction to AI and ML, Brief review of History of AI and ML, Related fields; Introduction to Artificial Neural Networks: Biological Neurons and Biological Neural Networks, Artificial Neural Networks, Activation Functions, Perceptron NN, Multilayer Perceptron NN, Back-propagation Neural Networks, Training Methods, Basic definition of supervised and unsupervised Learning; Introduction to Machine Learning: Introduction (Different Types of Learning) Hypothesis Space, Inductive Bias, Evaluation and Cross Validation |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |   |
| UNIT II                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 9 |

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|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| Application of AI/ML in Structural Analysis; Design Optimization Techniques using Genetic Algorithms and Neural Networks, Case Studies: Predictive Maintenance and Optimal Design Solutions, Structural health monitoring with AI techniques, Case studies: predictive modeling for structural integrity assessment                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |          |
| <b>UNIT III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>9</b> |
| Introduction to design optimization, Genetic algorithms and optimization techniques; Neural network-based optimization; Application of ML in optimal design of civil engineering structures                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |          |
| <b>UNIT IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>9</b> |
| Introduction to construction management, Schedule optimization using ML algorithms, Resource allocation and risk management with AI, Predictive analytics for infrastructure maintenance; Case studies: AI-driven construction project management systems; Introduction to infrastructure monitoring, IoT and sensor data integration with ML, Implementation of AI and ML algorithms using Python; Ethical considerations in AI and ML applications, Regulatory challenges and standards in civil engineering, Future trends and emerging technologies in AI and ML for civil engineering                                                                                                                                                                                                                                                                      |          |
| <b>Textbooks</b> <ol style="list-style-type: none"> <li>1. Machine Learning with Python for Everyone, Mark Fenner, Pearson</li> <li>2. Machine Learning, Anuradha Srinivasaraghavan, Vincy Joseph, Wiley</li> <li>3. Machine Learning with Python, U Dinesh Kumar Manaranjan Pradhan, Wiley</li> <li>4. Neural Networks, Fuzzy Logic, and Genetic Algorithms : Synthesis and Applications By S. Rajshekharan, G. A. Vijayalakshmi Pai, PHI</li> </ol> <b>Reference Books</b> <ol style="list-style-type: none"> <li>1. Kishan Mehrotra, Chilukuri Mohan and Sanjay Ranka, Elements of Artificial Neural Networks, Penram International</li> <li>2. Tom Mitchell, Machine Learning, TMH</li> <li>3. Athem Ealpaydin, Introduction to Machine Learning, PHI 8. Andries P. Engelbrecht, Computational Intelligence - An Introduction, Wiley Publication</li> </ol> |          |

| ECE 801                          |   | DESIGN OF MASONRY STRUCTURES                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|----------------------------------|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course category</b>           | : | Professional Elective – 8                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Pre-requisite Subject</b>     | : | NIL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Contact hours/week</b>        | : | Lecture : 3, Tutorial : 1 , Practical: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Number of Credits</b>         | : | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Course Assessment methods</b> | : | Continuous assessment through tutorials, attendance, home assignments, quizzes, viva voce, One Minor Test, and One Major Theory Examination                                                                                                                                                                                                                                                                                                                                                    |
| <b>Course Objectives</b>         | : | To make the students learn about masonry structures and their design aspect including reinforced masonry and masonry walls in composite action.                                                                                                                                                                                                                                                                                                                                                |
| <b>Course Outcomes</b>           | : | <p>The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course:</p> <ol style="list-style-type: none"> <li>1. Describe about masonry construction</li> <li>2. Assess the strength and stability of masonry walls</li> <li>3. Explain the design aspects of reinforced masonry</li> <li>4. Design a masonry wall</li> <li>5. Describe the behaviour of reinforced masonry &amp; masonry walls in composite action</li> </ol> |

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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 6. Apply codal provisions to evaluate and design masonry structures under practical loading conditions. |
| <b>Topics Covered</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                         |
| <b>UNIT I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>9</b>                                                                                                |
| Masonry Construction: Brick, stone and block masonry units – strength, modulus of elasticity and water absorption of masonry materials –classification and properties of mortars, selection of mortars. Defects and errors in masonry construction, cracks in masonry, types, reasons for cracking, methods of avoiding cracks.                                                                                                                                                                                          |                                                                                                         |
| <b>UNIT II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>9</b>                                                                                                |
| Strength and Stability: Strength and Stability of concentrically loaded masonry walls, effect of unit strength, mortar strength, joint thickness, rate of absorption, effect of curing, effect of ageing, workmanship, strength formulae and mechanism of failure for masonry subjected to direct compression.                                                                                                                                                                                                           |                                                                                                         |
| <b>UNIT III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>9</b>                                                                                                |
| Design Considerations: Effective height of walls, opening in walls, effective length, effective thickness, slenderness ratio, eccentricity, load dispersion, arching action, lintels.                                                                                                                                                                                                                                                                                                                                    |                                                                                                         |
| <b>UNIT IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>9</b>                                                                                                |
| Design of Masonry Walls: Design of load bearing masonry for building up to 3 storeys using IS: 1905 and SP: 20 procedures.                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                         |
| <b>Text Books:</b><br>1. Henry, A.W, “Structural masonry”, Macmillan Education Ltd., 1990.<br>2. Dayarathnam.P, “Brick and reinforced brick structures”, Oxford & IBH Publication, 1987. <b>References:</b><br>1. Sinha, B.P and Davies, S.R, “Design of Masonry Structures”, E & FN spon, 1997.<br>2. IS 1905-1987, “Code of practice for structural use of unreinforced masonry”, 3rd Revision, BIS, New Delhi.<br>3. SP 20 (S&T), “Hand book on Masonry Design and Construction”, 1st Revision, BIS, New Delhi, 1991. |                                                                                                         |

| <b>ECE 802</b>                   |   | <b>ADVANCED FOUNDATION ENGINEERING</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |  |
|----------------------------------|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| <b>Course category</b>           | : | Professional Elective – 8                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |
| <b>Pre-requisite Subject</b>     | : | Foundation Engineering (BCE 301)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  |
| <b>Contact hours/week</b>        | : | Lecture: 3, Tutorial:1, Practical: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |  |
| <b>Number of credits</b>         | : | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  |
| <b>Course Assessment Methods</b> | : | Continuous assessment through tutorials, attendance, home assignments, quizzes, record, one minor test, and one Major Theory Examination.                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |
| <b>Course Objectives</b>         | : | To enable students to understand the advanced behaviour and design of shallow and deep foundations, pile and caisson systems, earth-retaining structures, and machine foundation analysis under static and dynamic loading conditions.                                                                                                                                                                                                                                                                                                                                           |  |
| <b>Course Outcomes</b>           | : | The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course: <ol style="list-style-type: none"> <li>1. Apply soil–foundation interaction concepts in advanced foundation analysis.</li> <li>2. Analyse and design raft (mat) foundations.</li> <li>3. Evaluate axial capacity of single piles and interpret load tests.</li> <li>4. Analyse pile group behaviour including settlement and negative skin friction.</li> <li>5. Assess laterally loaded piles and special deep foundations (well and</li> </ol> |  |



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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | caisson).                                                      |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 6. Perform dynamic analysis and design of machine foundations. |
| <b>Topics Covered</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                |
| <b>UNIT-I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>9</b>                                                       |
| <b>Raft Foundations and Soil–Structure Interaction:</b> Raft foundations for buildings and tower structures, types of rafts, soil–structure interaction concepts, modulus of subgrade reaction, contact pressure variation, nonlinear behaviour of soil–foundation system, analysis and design considerations of raft foundations.                                                                                                                                                                                                                                                                                                                                               |                                                                |
| <b>UNIT-II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>9</b>                                                       |
| <b>Advanced Pile Foundation Analysis:</b> Pile foundations: types and methods of installation, load carrying capacity of single pile, static and dynamic analysis of piles, pile load tests and codal provisions, pile groups in sands and clays – settlement and group efficiency, negative skin friction, behaviour of piles under lateral loading using Winkler’s theory, batter piles – analysis concepts.                                                                                                                                                                                                                                                                   |                                                                |
| <b>UNIT-III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>9</b>                                                       |
| <b>Special Deep Foundations for Heavy Structures:</b> Foundations for heavy structures, well foundations and caisson foundations, construction methods and equipment, stability considerations, load transfer mechanisms, settlement behaviour and design principles.                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                |
| <b>UNIT-IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>9</b>                                                       |
| <b>Machine Foundations:</b> Types of machine foundations, theory of vibrations, free and forced vibrations of single degree freedom system, damping effects, dynamic soil properties, permissible amplitudes, design criteria for machine foundation blocks and vibration isolation principles.                                                                                                                                                                                                                                                                                                                                                                                  |                                                                |
| <b>Textbooks:</b> <ol style="list-style-type: none"> <li>1. Das, B. M. (2011). Principles of Foundation Engineering (7th ed.). Stamford, CT, USA: Cengage Learning.</li> <li>2. Bowles, J. E. (1996). Foundation Analysis and Design (5th ed.). New York, USA: McGraw-Hill Education.</li> <li>3. Tomlinson, M. J., &amp; Woodward, J. (2014). Foundation Design and Construction (7th ed.). Harlow, England: Pearson Education Ltd.</li> </ol>                                                                                                                                                                                                                                  |                                                                |
| <b>Reference books:</b> <ol style="list-style-type: none"> <li>5. Saran, S. (2006). Analysis and Design of Substructures (2nd ed.). New Delhi, India: Oxford &amp; IBH Publishing Co. Pvt. Ltd.</li> <li>6. Murthy, V. N. S. (2002). Soil Mechanics and Foundation Engineering (1st ed.). New Delhi, India: CBS Publishers &amp; Distributors.</li> <li>7. Ranjan, G., &amp; Rao, A. S. R. (1991). Basic and Applied Soil Mechanics (2nd ed.). New Delhi, India: New Age International (Publishers).</li> <li>8. Srinivasulu, P., &amp; Vaidyanathan, C. V. (2009). Handbook of Machine Foundations (3rd ed.). New Delhi, India: Tata McGraw-Hill Publishing Company.</li> </ol> |                                                                |

| ECE 803                          |   | ENVIRONMENTAL IMPACT ASSESSMENT                                                                                                             |
|----------------------------------|---|---------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course category</b>           | : | Professional Elective – 8                                                                                                                   |
| <b>Pre-requisite Subject</b>     | : | NIL                                                                                                                                         |
| <b>Contact hours/week</b>        | : | Lecture : 3, Tutorial : 1 , Practical: 0                                                                                                    |
| <b>Number of Credits</b>         | : | 4                                                                                                                                           |
| <b>Course Assessment methods</b> | : | Continuous assessment through tutorials, attendance, home assignments, quizzes, viva voce, One Minor Test, and One Major Theory Examination |

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|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course Objective</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | : | To make the students understand the basic principles of environmental impact assessment and their application to assess risks posing threats to the environment.                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Course Outcomes</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | : | <p>The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course:</p> <ol style="list-style-type: none"> <li>1. Able to explain the concepts about the Environmental Impact Assessment (EIA).</li> <li>2. Able to evaluate the subjects which must be considered in EIA projects.</li> <li>3. Knowledge about various screening methods for EIA</li> <li>4. Able to overview of assessing risks posing threats to the environment</li> <li>5. Able to access different case studies/examples of EIA in practice</li> <li>6. Able to prepare EIA reports.</li> </ol> |
| <b>Topics Covered</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>UNIT I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Introduction: Environment and its components, Concept of Ecological imbalances, carrying capacity and sustainable development Legal, Policy & Regulatory framework: Legislative and environmental clearance procedures in India and other countries, Impact Assessment Methodologies? Matrices, overlays, network analysis                                                                                                                                                                                                                                                                                                                         |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>UNIT II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| EIA Procedure - Scoping & Screening: Evolution of environmental impact assessment (EIA), Current screening process in India. A step-by-step procedure for developing EIA, Elements of Environmental Analysis. EIA Methodologies and Impact Identification: Public consultation, Post monitoring, Data collection for Air Quality Impact analysis, Environmental health impact assessment, Environmental risk analysis, Economic valuation methods, Cost-benefit analysis                                                                                                                                                                           |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>UNIT III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Prediction & Assessment of Impacts on the Water and Soil Environment; Water Quality Impact Analysis and energy impact analysis, Impact Analysis of Water resources projects, Prediction & Assessment of Impacts on the Soil Environment                                                                                                                                                                                                                                                                                                                                                                                                            |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>UNIT IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| EIA Case Studies, EIA Reporting & Review of EIA; Case studies of Industrial and other EIA projects, Brief introduction about Environment legislation and Environmental Audit, Practical applications of EIA methodologies.                                                                                                                                                                                                                                                                                                                                                                                                                         |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Textbooks</b> <ol style="list-style-type: none"> <li>1. Environmental Impact Assessment by C.W. Canter</li> <li>2. Environmental Impact Assessment for Developing Countries: Asit K. Biswas</li> <li>3. A Chadwick, <i>Introduction to Environmental Impact Assessment</i>, Taylor &amp; Francis , 2007</li> </ol> <b>Reference Books</b> <ol style="list-style-type: none"> <li>1. R.Therirvel, E. Wilson, S. Hompson, D. Heaney, D.Pritchard, <i>Strategic Environmental Assessment</i>, Earthscan, London , 1992</li> <li>2. Paul, A Erickson, <i>A Practical Guide to Environmental Impact Assessment</i>, Academic Press , 1994</li> </ol> |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

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| <b>ECE 804</b>               | <b>PLANNING, DESIGN AND CONSTRUCTION OF RURAL ROADS</b> |                               |
| <b>Course category</b>       | :                                                       | Professional Elective – 8     |
| <b>Pre-requisite Subject</b> | :                                                       | Highway Engineering (BCE 263) |

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| <b>Contact hours/week</b>                                                                                                                                                                                                                                                                                                                                                                                                                                    | : | Lecture : 3, Tutorial : 1, Practical: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Number of Credits</b>                                                                                                                                                                                                                                                                                                                                                                                                                                     | : | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Course Assessment methods</b>                                                                                                                                                                                                                                                                                                                                                                                                                             | : | Continuous assessment through tutorials, attendance, home assignments, quizzes, viva voce, One Minor Test, and One Major Theory Examination                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Course Objective</b>                                                                                                                                                                                                                                                                                                                                                                                                                                      | : | To make the students aware the knowledge of rural road planning approaches, their design and construction using sustainable approaches.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Course Outcomes</b>                                                                                                                                                                                                                                                                                                                                                                                                                                       | : | The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course:<br>1. Explain rural road planning approaches, models, and optimal network concepts.<br>2. Apply geometric design standards for rural and hill roads as per PMGSY guidelines.<br>3. Design flexible and rigid pavements for rural roads using relevant IRC provisions.<br>4. Identify road failures and suggest suitable remedial measures.<br>5. Select appropriate conventional, marginal, and waste materials and apply suitable mix design methods.<br>6. Describe low-cost construction techniques and waste material utilization in rural roads, including hill area considerations. |
| <b>Topics Covered</b>                                                                                                                                                                                                                                                                                                                                                                                                                                        |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>UNIT I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Planning of Rural Roads: Classification of roads, brief introduction to earlier 20 year plans, system's approach, NATPAC model, gravity model, CRR I model, Accessibility Based Rural Network Planning model, concept of link efficiency, optimal road network planning approach.                                                                                                                                                                            |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>UNIT II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                               |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Geometric Design: Geometric design standards for rural roads with special reference to PMGSY, hill road standards. Pavement Design: Various pavement design methods for rural roads including flexible and rigid pavements using IRC:SP-20, IRC-72, IRC-37, IRC:SP-62, CRR I nomograms., Type and causes of road failures and their remedial measures                                                                                                        |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>UNIT III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                              |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Materials and Mix design methods: Conventional materials, marginal and waste materials including fly ash, Granular Blast Furnace Slag (GBFS), Blast Furnace Slag (BFS), Steel Making Slag (SMS), bagasse and Crum Rubber Modified Binder (CRMB), etc. Mix Design Methods: CRR I method, triangular chart method, Fuller's method, Rothfuch method, PI based method.                                                                                          |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>UNIT IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                               |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Construction: Low cost techniques for rural road construction, tractor bound technology, special considerations for hill areas; Case studies of waste material utilization in rural roads                                                                                                                                                                                                                                                                    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Reference Books:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                      |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 1. "Rural Roads Manual", SP-20, IRC. 2002<br>2. "Document on Rural Road Development", Vol. I & II, CRR I. 1990<br>3. "PMGSY Operation Manual", NRRDA. 2005<br>4. "Specifications for Rural Roads", MoRD, IRC. 2004<br>5. Khanna, S.K. and Justo, C.E.G., "Highway Engineering", Nem Chand & Bros. 2004<br>6. Kadiyali, L.R., "Traffic Engineering and Transport Planning", Khanna Publishers. 1999<br>7. "Quality Assurance Handbook for Rural Roads", NRRDA |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

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| <b>ECE 805</b>                                                                                                                                                                                                                                                                                                                                                                                                    | <b>URBAN STORMWATER MANAGEMENT</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Course category</b>                                                                                                                                                                                                                                                                                                                                                                                            | :                                  | Professional Elective – 8                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Pre-requisite Subject</b>                                                                                                                                                                                                                                                                                                                                                                                      | :                                  | NIL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Contact hours/week</b>                                                                                                                                                                                                                                                                                                                                                                                         | :                                  | Lecture : 3, Tutorial : 1 , Practical: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Number of Credits</b>                                                                                                                                                                                                                                                                                                                                                                                          | :                                  | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Course Assessment methods</b>                                                                                                                                                                                                                                                                                                                                                                                  | :                                  | Continuous assessment through tutorials, attendance, home assignments, quizzes, viva voce, One Minor Test, and One Major Theory Examination                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Course Objective</b>                                                                                                                                                                                                                                                                                                                                                                                           | :                                  | To make the students understand the dynamics of urban hydrological cycle and provide knowledge of suitable stormwater management techniques                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Course Outcomes</b>                                                                                                                                                                                                                                                                                                                                                                                            | :                                  | The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course:<br>1. Explain the effect urbanization has on water pathways<br>2. Describe the effects of climate change on rainfall and urban hydrology<br>3. Compare different stormwater control measures<br>4. Explain the contribution of stormwater control measures to urban climate adaption<br>5. Reflect on the importance of stormwater in the urban planning process<br>6. Learn about various stormwater models |
| <b>Topics Covered</b>                                                                                                                                                                                                                                                                                                                                                                                             |                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>UNIT I</b>                                                                                                                                                                                                                                                                                                                                                                                                     |                                    | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Urban Hydrology and Stormwater: Urban hydrology and stormwater problems; Interaction of land use and urban storm runoff; stormwater planning in urban areas; new directions in urban hydrology and stormwater management; Rainfall Abstractions: Introduction; interception; depression storage; infiltration processes; SCS method; phi-index; importance of losses in urbanized basins                          |                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>UNIT II</b>                                                                                                                                                                                                                                                                                                                                                                                                    |                                    | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Urban Runoff Processes: Introduction; surface runoff subsystem; transport subsystem; time of concentration for urban drainage system; urban runoff calculation methods; Urban Runoff Quality: Pollution potential of stormwater; sources of pollutants; entry of pollutants into urban runoff; estimation of pollution rate; washoff of pollutants from undeveloped areas; environmental assessment consideration |                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>UNIT III</b>                                                                                                                                                                                                                                                                                                                                                                                                   |                                    | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Data Collection: Data collection strategy; types of data and examples; rainfall and streamflow data collection; pollutant data; land use characteristics                                                                                                                                                                                                                                                          |                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>UNIT IV</b>                                                                                                                                                                                                                                                                                                                                                                                                    |                                    | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Overview of Urban Stormwater Models: Introduction; role of urban stormwater models; planning models; design and analysis models; operation and control models; data requirements; model calibration, validation, and verification                                                                                                                                                                                 |                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Textbook</b>                                                                                                                                                                                                                                                                                                                                                                                                   |                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 1. David F Kibler and Delleur, J. W., Introduction to urban hydrology and stormwater management, American Geophysical Union, 2013.<br>2. Shaw L Yu, Stormwater management for transportation facilities, National Cooperative Highway Research Program, 174, Transportation Research Board, USA, 1993.<br>3. Wanielista and Eglin, Hydrology – Quantity and Quality Control, Wiley, 2006                          |                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Reference Book</b>                                                                                                                                                                                                                                                                                                                                                                                             |                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

1. Statre P and Urbanos, Stormwater deduction for drainage and CSO management, Prentice Hall, 2003

| ECE 901                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |   | SEISMIC DESIGN OF STRUCTURES                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |   |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
| Course category                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | : | Professional Elective – 9                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |   |
| Pre-requisite Subject                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | : | NIL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |   |
| Contact hours/week                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | : | Lecture: 3, Tutorial:1, Practical: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |   |
| Number of credits                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | : | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |   |
| Course Assessment methods                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | : | Continuous assessment through tutorials, attendance, home assignments, quizzes and One Minor test and One Major Theory Examination                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |   |
| Course Objective                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | : | To make the students understand the basic of seismic load and their application in design of structures.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |   |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | : | The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course:<br>1. To introduce nature and characteristics of various dynamics loads.<br>2. To have considerable knowledge of theory of vibrations including multi-degree of freedom systems.<br>3. To assess of structural failure due to earthquakes.<br>4. To analyze and design structures subjected to seismic loading as per IS codes.<br>5. To introduce ductile detailing of structures, concept of soft story and design of shear walls as per IS codes.<br>6. Understand the concept of base shear, natural time period and natural frequency. |   |
| Topics Covered                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |   |
| UNIT I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 9 |
| Seismological background: Seismicity of a region, earthquake faults and waves, structure of earth, plate tectonics, elastic-rebound theory of earthquake, Richter scale, measurement of ground motion, seismogram                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |   |
| UNIT II                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 9 |
| Definitions of basic problems in dynamics, static versus dynamic loads, different types of dynamic loads, un-damped and damped vibration of SDOF system, natural frequency, and periods of vibration, damping in structure, response to periodic loads, response to general dynamic load, response of structure subject to gravitational motion, lumped SDOF elastic systems, translational excitation.                                                                                                                                                                                                                                                                                                              |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |   |
| UNIT III                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 9 |
| Multi Degree of Freedom Systems Two degree and multi-degree freedom systems lumped MDOF elastic systems, translational excitation time history analysis, multistoried buildings with symmetric plans, multistoried buildings with unsymmetrical plans, combining maximum modal responses using mean square response of a single mode, SRSS and CQCC combination of modal responses. earthquake response spectra, factors influencing response spectra, design response spectra for elastic systems, peak ground acceleration, response spectrum shapes, deformation, pseudo-velocity, pseudo- acceleration response spectra, peak structural response from the response spectrum, response spectrum characteristics. |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |   |
| UNIT IV                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 9 |

Concepts of Earthquake Resistant Design of Reinforced Concrete Buildings – Earthquake and vibration effects on structure, identification of seismic damages in R.C. buildings, Effect of structural irregularities on the performance of R.C. buildings during earthquakes and seismo- resistant building architecture Seismic Analysis and Modelling of R.C. Buildings: I. S. code method of seismic analysis: seismic coefficient method and its limitation, response spectrum method, IS: 1893 (Part 1)-2016. seismic design considerations, allowable ductility demand, ductility capacity, reinforcement detailing for members and joints as per IS 13920 - 2016, E.R.D. of R.C. building.

#### **Textbooks**

1. Earthquake Resistant Design of Structures - P. Agarwal & M. Shrikhande
2. Structural Dynamics – Theory & Computation - Mario Paz
3. Dynamics of Structures Theory and Applications to Earthquake Engineering - Anil K. Chopra

#### **Reference books**

1. Introduction to Structural Dynamics - J.M. Biggs
2. Elements of Earthquake Engineering - Jai Krishna and A.R. Chandrasekharan
3. Fundamental of Earthquake Engineering - N.M. Neumarks and E. Rosenblueth
4. Engineering Vibrations - L.S. Jacobsen & R.S. Ayre
5. Structural Dynamics - R. Roy Craig Jr.
6. Dynamics of Structures - R.W. Clough & J. Penjien 3. Reinforced Concrete Design by P. Dayaratnam.

| <b>ECE 902</b>                                                                                                                                                                                                        |   | <b>FOUNDATION ON EXPANSIVE SOIL</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
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| <b>Course category</b>                                                                                                                                                                                                | : | Professional Elective – 9                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Pre-requisite Subject</b>                                                                                                                                                                                          | : | Foundation Engineering (BCE 301)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Contact hours/week</b>                                                                                                                                                                                             | : | Lecture: 3, Tutorial:1, Practical: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Number of credits</b>                                                                                                                                                                                              |   | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Course Assessment Methods</b>                                                                                                                                                                                      | : | Continuous assessment through tutorials, attendance, home assignments, quizzes, record, One Minor Test, and one Major Theory Examination.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Course Objective</b>                                                                                                                                                                                               |   | To provide an exposure on the properties of expansive soils and to study about the substructures placed on expansive soils.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Course Outcomes</b>                                                                                                                                                                                                | : | The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course: <ol style="list-style-type: none"> <li>1. To assess the occurrence and distribution of expansive soils.</li> <li>2. To study the properties of expansive soils</li> <li>3. To study the controlling techniques of expansive soils.</li> <li>4. To understand various methods of stabilization of expansive soils and foundations used in expansive soils.</li> <li>5. Design foundations on expansive soil.</li> <li>6. Select suitable techniques and understand the mechanism of treatment of swelling Soils.</li> </ol> |
| <b>Topics Covered</b>                                                                                                                                                                                                 |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>UNIT I</b>                                                                                                                                                                                                         |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| General principles: Origin of expansive soils, Physical properties of expansive soils, Mineralogical composition, Identification of expansive soils, Field conditions that favour swelling, Consequences of swelling. |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>UNIT II</b>                                                                                                                                                                                                        |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

Swelling characteristics: Swelling characteristics, Laboratory tests, Prediction of swelling characteristics, Evaluation of heave. Techniques for controlling swelling: Horizontal moisture barriers, Vertical moisture barriers, Surface and subsurface drainage, Pre-wetting, Soil replacement, Sand cushion techniques, CNS layer technique.

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| <b>UNIT III</b> | <b>9</b> |
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Foundations on expansive soils: Belled piers, Bearing capacity and skin friction, Advantages and disadvantages, Design of belled piers, Under reamed piles, Design and construction.

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| <b>UNIT IV</b> | <b>9</b> |
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Modification of swelling characteristics: Lime stabilization, Mechanisms, Limitations, Lime injection, Lime columns, Mixing, Chemical stabilization, Construction.

**Textbooks/ Reference books**

1. Fu Hua Chen, Foundations on Expansive Soils, Elsevier Scientific Publishing Company, New York.
2. Gopal Ranjan & A.S. Rao, Basic and Applied Soil Mechanics, New Age International Publishers – New Delhi.
3. Handbook on Underreamed and Bored Compaction Pile Foundation, CBRI, Roorkee.
4. IS: 2720 (Part XLI) – 1977 – Measurement of Swelling Pressure of Soils.
5. R.K. Katti, Search for Solutions in Expansive Soils.
6. Alam Singh, Modern Geotechnical Engineering, Geo-Environ Academia, Jodhapur.
7. Swami Saran, Analysis and Design of Substructures, Oxford & IBH, New Delhi.

| CE 903                                                                                                                                                                                                                                                                                                                                                  |   | ENVIRONMENTAL DATA SCIENCE AND ANALYTICS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
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| Course category                                                                                                                                                                                                                                                                                                                                         | : | Professional Elective – 9                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Pre-requisite Subject                                                                                                                                                                                                                                                                                                                                   | : | NIL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Contact hours/week                                                                                                                                                                                                                                                                                                                                      | : | Lecture: 3, Tutorial:1, Practical: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Number of credits                                                                                                                                                                                                                                                                                                                                       | : | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Course Assessment Methods                                                                                                                                                                                                                                                                                                                               | : | Continuous assessment through tutorials, attendance, home assignments, quizzes, record, One Minor test, and one Major Theory Examination.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Course Objective                                                                                                                                                                                                                                                                                                                                        | : | To familiarize the students with application of data analysis in environmental engineering                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                         | : | <p>The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course:</p> <ol style="list-style-type: none"> <li>1. Identify and pre-process various types of environmental datasets for analysis.</li> <li>2. Apply statistical tests to validate environmental hypotheses and detect trends.</li> <li>3. Develop machine learning models to predict and classify environmental phenomena.</li> <li>4. Utilize GIS and time-series tools to visualize and solve spatial environmental problems.</li> <li>5. Application of big data for environmental analysis problems</li> <li>6. Application of IoT for environmental engineering problems</li> </ol> |
| <b>Topics Covered</b>                                                                                                                                                                                                                                                                                                                                   |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>UNIT I</b>                                                                                                                                                                                                                                                                                                                                           |   | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Foundations of Environmental Data & Probability: Nature of Data Spatial: pollution at different locations, Temporal: pollution over time, Spatiotemporal: pollution across space and time, Sources: IoT sensors, satellites (remote sensing), USGS/EPA databases Data Pre-processing, Probability Distributions, Descriptive Statistics & Visualization |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

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| <b>UNIT II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>9</b> |
| Statistical Inference & Hypothesis Testing: Sampling Designs, Parametric Tests: t-tests and ANOVA for comparing pollution levels across different sites or time periods., Non-Parametric Tests: Mann-Kendall test for trend analysis in climate data; Wilcoxon rank-sum test., Regression Analysis: Simple and multiple linear regression for predicting environmental parameters (BOD prediction based on temperature and pH).                                                                                       |          |
| <b>UNIT III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>9</b> |
| Machine Learning for Environmental Systems: Machine Learning: Types Classification, Supervised Learning: Classification: Identifying land cover types using satellite imagery (Random Forest, SVM)., Regression: Predicting Air Quality Index (AQI) using meteorological data., Unsupervised Learning: Clustering: Grouping monitoring stations with similar pollution profiles (K-means). Principal Component Analysis (PCA): Reducing dimensions in complex chemical datasets to identify primary pollution sources |          |
| <b>UNIT IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>9</b> |
| Sensing, Big Data & Decision Support Systems: IoT & Sensors: Real-time data acquisition from smart water meters and air quality sensors. Environmental Modelling: Integration of data analytics with physical models (e.g., Fate and Transport models). Decision Support: Multi-Criteria Decision Making (MCDM) for waste management site selection. Ethical Considerations: Data privacy in smart cities and environmental justice in data representation.                                                           |          |
| <b>Textbooks/Reference Books</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |          |
| 1. Devore, Jay L. <i>Probability and Statistics for Scientists and Engineers</i> . Duxbury Press, 2000.                                                                                                                                                                                                                                                                                                                                                                                                               |          |

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| <b>ECE 904</b>                   | <b>PAVEMENT EVALUATION, REHABILITATION AND MAINTENANCE</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Course category</b>           | :                                                          | Professional Elective – 9                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Pre-requisite Subject</b>     | :                                                          | NIL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Contact hours/week</b>        | :                                                          | Lecture: 3, Tutorial:1, Practical: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Number of credits</b>         | :                                                          | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Course Assessment Methods</b> | :                                                          | Continuous assessment through tutorials, attendance, home assignments, quizzes, record, One Minor test, and one Major Theory Examination.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Course Objective</b>          | :                                                          | To develop understanding of Pavement Management Systems, pavement evaluation and distress assessment, and the selection of appropriate maintenance and rehabilitation strategies.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Course Outcomes</b>           | :                                                          | <p>The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course:</p> <ol style="list-style-type: none"> <li>1. Explain the concepts, components, and process of Pavement Management Systems (PMS).</li> <li>2. Identify highway maintenance and rehabilitation problems and planning approaches.</li> <li>3. Evaluate pavement performance, structural capacity, distress, and safety parameters.</li> <li>4. Conduct pavement distress surveys and interpret condition data.</li> <li>5. Analyze causes and treatments of distresses in flexible and rigid pavements.</li> <li>6. Select suitable maintenance and rehabilitation strategies for pavement systems.</li> </ol> |
| <b>Topics Covered</b>            |                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>UNIT I</b>                    |                                                            | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |



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| Introduction: Definition of Pavement Management System(PMS), Need of PMS, Pavement Management as an Engineering Management System, Pavement Management Process, Basic Components of PMS, Problems of Highway Maintenance and Rehabilitation(M&R), Approaches to Pavement Management, Classification and Planning of Maintenance                                                                                                                                                                                                                                                                                                                                                                                     |          |
| <b>UNIT II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>9</b> |
| Pavement Evaluation and Performance: General Concept of Pavement Evaluation, Evaluation of Pavement Performance, Evaluation of Pavement Distress, Evaluation of Pavement Safety (Roughness and Skid Resistance), NDT Testing.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |          |
| <b>UNIT III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>9</b> |
| Pavement Distress Survey and Rating Procedures: Overview, Importance of Pavement Condition Data, Types of Distresses in Flexible and Rigid Pavement, Distress Symptoms, Cause & Treatment,                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |          |
| <b>UNIT IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>9</b> |
| Maintenance & Rehabilitation Selection: Classification of M&R, Rehabilitation Strategies, Pavement M&R Alternatives, Flexible and Rigid Pavement Maintenance Techniques, Use of Expert Systems in the Selection of M &R Strategies.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |          |
| <b>Reference Books:</b> <ol style="list-style-type: none"> <li>1. Huss and Hudson, Modern Pavement Management system, McGraw Hill</li> <li>2. Shahin M.Y., Pavement management for roads, airport and parking lots, KLUWER ACADEMIC PUB, Boston/London</li> <li>3. Khanna, S. K. and Justo, C. E G., Highway Engineering, Nemchand Bros., Roorkee</li> <li>4. Kadiyali, L. R., Pr. and design of pavements, Khanna Publishers, New Delhi.</li> <li>5. Yoder E.J. and Witczale M.W., Principles of pavement design, John Wiley &amp; Sons, Inc, New York</li> <li>6. Huang, Y. H., Pavement analysis and Design. Prentice Hall, Englewood Cliffs, New Jersey.</li> <li>7. IRC codes (IRC 83), ASTM D 6433</li> </ol> |          |

| ECE 905                          |   | GEOINFORMATICS FOR WATER RESOURCES                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
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| <b>Course category</b>           | : | Professional Elective – 9                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Pre-requisite Subject</b>     | : | NIL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Contact hours/week</b>        | : | Lecture: 3, Tutorial:1, Practical: 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Number of credits</b>         | : | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Course Assessment Methods</b> | : | Continuous assessment through tutorials, attendance, home assignments, quizzes, record, One Minor test, and one Major Theory Examination.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Course Objective</b>          | : | Enhance the capability and advanced knowledge of Geoinformatics tools and technique to understand, monitor, mapping and management of Water Resources in various aspects.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Course Outcomes</b>           | : | <p>The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course:</p> <ol style="list-style-type: none"> <li>1. Develop appropriate methods for studying and/or solving the problems related to hydrological cycle, estimation of hydrological parameter and water budget with the help of RS&amp;GIS</li> <li>2. Acquire know-how in watershed mapping, classification, and prioritization</li> <li>3. Able to provide geo-information science and earth observation technology to watershed management and prioritization</li> <li>4. Hands on training on geoinformatics tools and technique in the application of water resources</li> </ol> |

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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 5. Knowledge of snow/glacier mapping and sedimentation analysis due to snow melt<br>6. Application of GIS and remote sensing for oceanographic studies |
| <b>Topics Covered</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                        |
| <b>UNIT I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>9</b>                                                                                                                                               |
| Overview of RS & GIS Application in Water Resources Management: Hydrological Modelling with Geospatial Inputs; Hydrological cycle, Estimation of precipitation, Hydrological Parameter Estimation using RS & GIS; Digital Elevation Model (DEM) hydro processing; Drainage network and drainage pattern, watershed definition and scope, morphometric parameter                                                                                                                                                                                                                                                                                                  |                                                                                                                                                        |
| <b>UNIT II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>9</b>                                                                                                                                               |
| Watershed Characterization: Watershed Prioritization and Conservation Planning; Aquatic System; Classification of Wetland and Wetland mapping using Remote Sensing; Water balance studies- interception, soil moisture, evaporation, run off and discharge                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                        |
| <b>UNIT III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>9</b>                                                                                                                                               |
| Snow/Glacier Mapping: Monitoring and Snow Melt Runoff Model; Soil erosion and Sediment modelling, Reservoir Sedimentation Assessment using Remote Sensing                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                        |
| <b>UNIT IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>9</b>                                                                                                                                               |
| Application of remote sensing in Oceanography: Sea Surface Temperature, Chlorophyll, Total Suspended Solids, Fishing potential and Coastal wetland. Monitoring of Hydro- meteorological Disasters and Damage Assessment; Flood Modelling and Early Warning Systems                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                        |
| <b>Textbooks/Reference Books</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                        |
| 1. Jensen J. R, Remote Sensing of the Environment: An Earth Resource Perspective, Pearsons, 2009.<br>2. Lillesand T, Kiefer RW and Chipman J, Remote Sensing and Image Interpretation, Wiley & Sons. 2009.<br>3. Chang K., Introduction to Geographic Information Systems, McGraw-Hill, New York, 2006.<br>4. JVS Murty, 2004, "Watershed management" New Age International Pvt Ltd, New Delhi<br>5. Lyon JG GIS for Water Resources and Watershed Management Chen Y, GIS and Remote Sensing in Hydrology, Water Resources and Environment, 2004<br>6. W.G.M. 1998. Remote sensing in water resources management: the state of the art. Colombo, Sri Lanka: IWMI |                                                                                                                                                        |

### **Skill-Based Courses to Qualify for UG Certificate (Engg.) in Civil Engineering**

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| <b>BCE 163</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>PLUMBING AND SANITATION</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Course category</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | :                              | Skill-based courses                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Pre-requisite Subject</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | :                              | NIL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Contact hours/week</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | :                              | Lecture: 2, Tutorial:0, Practical: 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Number of credits</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | :                              | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Course Assessment methods</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | :                              | Continuous assessment through tutorials, attendance, home assignments, quizzes, record, two Minor tests and One Major Theory Examination.                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Course Objectives</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | :                              | The objective of this course is to provide a student with basic knowledge in home–hold plumbing so that he/she should be able to design and analyse plumbing system for an individual residential/commercial/industrial building.                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Course Outcomes</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | :                              | <p>The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course</p> <ol style="list-style-type: none"> <li>1. Coordinate plumbing works from inception to completion with Owners, Architects, other consultants and contractors.</li> <li>2. Select proper plumbing materials and systems.</li> <li>3. Read and interpret plumbing drawings.</li> <li>4. Supervise code based plumbing installations.</li> <li>5. Understand methods to conserve water and energy.</li> <li>6. Protect health and safety of end users.</li> </ol> |
| <b>Topics Covered</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>UNIT-I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                | <b>6</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <p>Plumbing Terminology, Plumbing Fixtures: accessible, readily accessible, aerated fittings, AHJ, bathroom group, carrier, flood level rim, floor sink, flushometer valve, flush tanks, lavatories, macerating toilet, plumbing appliances, plumber. Traps: indirect waste, vent, blow off, developed length, dirty arm, FOG, indirect waste, receptors, slip joints, trap, and vent. Drainage: adapter fitting, adjusted roof area, AAV, air break, air gap, area drain, base, bell and spigot joint, building drain, branch, DFU, grease interceptor, joints, roof drain, smoke test, stack.</p> <p>Water supply: angle valve, anti-scald valve, backflow, bypass, check valve, cross connection, ferrule, gate valve, gray water, joints, PRV.</p>  |                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>UNIT-II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                | <b>6</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <p>Definitions of plumbing fixtures, fittings, appliances and appurtenances; maximum flow rates, water closets, bidets, urinals, flushing devices, washbasins, bath/shower, toilets for differently abled, kitchen sinks, water coolers, drinking fountain, clothes washer, dish washer, mop sink, overflows, strainers, prohibited fixtures, floor drains, floor slopes, location of valves, hot water temperature controls, installation standard dimensions in plan and elevation.</p>                                                                                                                                                                                                                                                               |                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>UNIT-III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                | <b>6</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <p>Discharge for indirect waste piping, nature of contents or systems, proper methods to install indirect waste piping, air gap and air break, sink traps, dish washers, drinking fountains, waste receptors, sterile equipment, appliances, condensers, point of discharge, venting.</p> <p>Vent requirement, purpose of venting, trap seal protection, materials, vent connections, flood rim level, termination, vent stacks, water curtain and hydraulic jump, cleanouts, venting of interceptors, introduction to vent sizing.</p>                                                                                                                                                                                                                 |                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>UNIT-IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                | <b>6</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <p>Rain Water Harvesting (RWH) definition, need, catchment, conduits, settlement tanks, treatment, possible uses, recharging pits, NBC requirements, MOEF&amp;CC requirements, and advantages of RWH.</p> <p>Hot water systems, individual and centralized systems, geysers, heaters, heat pumps, energy sources, solar hot water systems, types, boilers, hot water generators, hot water consumption pattern, introduction to sizing of systems.</p> <p>Definition of gray water, approvals, specifications and drawings, safety, total gray water discharge, holding tanks, valves and piping. Reclaimed water systems, definition of reclaimed water, pipe identification, installation, safety signs, valves, cross connection, approved uses.</p> |                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

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| <b>List of Practical</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  |
| <ol style="list-style-type: none"> <li>1. Demonstration of water supply pipes and fittings</li> <li>2. Cutting and joining water supply pipes and fittings</li> <li>3. Flow measurement of various plumbing fixtures and fittings</li> <li>4. Cutting and joining of drainage pipes, traps, and fittings</li> <li>5. Vent requirements for a residence</li> </ol>                                                                                                                                     |  |
| Design and demonstration of rain water harvesting system for an independent house                                                                                                                                                                                                                                                                                                                                                                                                                     |  |
| <b>Textbooks</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |
| <ol style="list-style-type: none"> <li>1. Uniform Illustrated Plumbing Code-India (UIPC-I) published by IPA and IAPMO (India)</li> <li>2 National Building Code (NBC) of India</li> <li>3 IS 17650 Part 1 and Part 2 for Water Efficient Plumbing Products</li> <li>4 Water Efficient Products-India (WEP-I) published by IPA and IAPMO (India)</li> </ol>                                                                                                                                            |  |
| <b>Reference books</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  |
| <ol style="list-style-type: none"> <li>1. Water Efficiency and Sanitation Standard (WE.Stand) published by IPA and IAPMO (India)</li> <li>2. Water Pollution, Berry, CBS Publishers.</li> <li>3. 'A Guide to Good Plumbing Practices', a book published by IPA</li> <li>4. Elements of Water Pollution Control Engineering, O.P. Gupta, Khanna Book Publishing, New Delhi.</li> <li>5. Ram Babn Sao, perfect knowledge of plumbing Handbook.</li> <li>6. Plumbing Book , by Chand Kumawat.</li> </ol> |  |

| BCE 164                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |   | COMPUTER AIDED DRAFTING.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course category</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | : | Skill-based courses                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Pre-requisite Subject</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | : | NIL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Contact hours/week</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | : | Lecture: 2, Tutorial:0, Practical: 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Number of credits</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | : | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Course Assessment methods</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | : | Continuous assessment through tutorials, attendance, home assignments, quizzes, record, two Minor tests and One Major Theory Examination.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Course Objectives</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | : | <ol style="list-style-type: none"> <li>1. The objective of this lab is to teach the student usage of Auto cad, basic drawing fundamentals in various civil engineering applications, especially in building drawing.</li> <li>2. The objective of this course is to teach students the basic commands and tools necessary for professional 2D drawing, 3D drawing and drafting using AutoCAD</li> <li>3. Students able to learn to sketch and take field dimensions.</li> <li>4. Students able to learn to take data and transform it into graphic drawings. Students able to learn basic engineering drawing formats</li> </ol> |
| <b>Course Outcomes</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | : | <p>The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course</p> <ol style="list-style-type: none"> <li>1. Understand CAD software and basic functions</li> <li>2. Evaluate plans of Single storied building &amp; multistoried buildings</li> <li>3. Develop different sections at different elevations</li> <li>4. Detailing of building components like doors, windows roof trusses</li> <li>5. Develop section and elevation for single and multistoried buildings using CAD software.</li> <li>6 Exposure to creating working drawings</li> </ol>      |
| <b>Topics Covered</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>UNIT-I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |   | <b>6</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <p>Overview of Computer Graphics covering, listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids];</p> |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

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| <b>UNIT-II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>6</b> |
| Customisation & CAD Drawing consisting of set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |          |
| <b>UNIT-III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>6</b> |
| Annotations, layering & other functions covering applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print command; orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation, Computer-aided design (CAD) software modelling of parts and assemblies. Parametric and non-parametric solid, surface, and wireframe models. Part editing and two-dimensional documentation of models. Planar projection theory, including sketching of perspective, isometric, Multiview, auxiliary, and section views. Spatial visualization exercises. Dimensioning guidelines, tolerancing techniques; dimensioning and scale multi views of dwelling; |          |
| <b>UNIT-IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>6</b> |
| Demonstration of a simple team design project that illustrates Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; meshed topologies for engineering analysis and tool-path generation for component manufacture; geometric dimensioning and tolerancing; Use of solid-modelling software for creating associative models at the component and assembly levels; floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc. Applying colour coding according to building drawing practice; Drawing sectional elevation showing foundation to ceiling; Introduction to Building Information Modelling (BIM).                                                                                                                                                                                                                           |          |
| <b>List of Experiments</b> <ol style="list-style-type: none"> <li>1. Prepare simple lines using basic commands</li> <li>2. Create basic shape using command</li> <li>3. Prepare plan, section and elevation of bungalow using 2D entity command, modification and other commands</li> <li>4. Create a presentation drawing in computer: layout plans, all floor plans, section and elevation</li> <li>5. Create a 3D view of a building with any 3D software such Google sketch-up, Revit</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |          |
| <b>Textbooks</b> <ol style="list-style-type: none"> <li>1. Bhatt N.D., Panchal V.M. &amp; Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House</li> <li>2. Shah, M.B. &amp; Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education</li> </ol> <b>Reference books</b> <ol style="list-style-type: none"> <li>1. Agrawal B. &amp; Agrawal C. M. (2012), Engineering Graphics, TMH Publication</li> <li>2. Narayana, K.L. &amp; P Kannaiah (2008), Textbook on Engineering Drawing, Scitech Publishers</li> <li>3. (Corresponding set of) CAD Software Theory and User Manuals</li> </ol>                                                                                                                                                                                                                                                                                                                                                                  |          |

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| <b>BCE 165</b>                   | <b>CARPENTRY AND FABRICATION</b>                                                                                                                                                                                                                                                                                                                                                       |
| <b>Course Category</b>           | Skilled Based Course                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Contact hours/week</b>        | Lecture – 2; Tutorial – 0; Practical – 2                                                                                                                                                                                                                                                                                                                                               |
| <b>Number of credits</b>         | 3                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Course assessment methods</b> | Continuous assessment through attendance, home assignments, quizzes, two minor practical exam and One Major Practical Examination                                                                                                                                                                                                                                                      |
| <b>Course Objectives</b>         | To familiarize a student with basic skills in carpentry and fabrication so that he/she can work with wood and metals.                                                                                                                                                                                                                                                                  |
| <b>Course Outcomes</b>           | At the end of the course student will be able to: <ol style="list-style-type: none"> <li>1. Identify and select the right type of wood for various applications.</li> <li>2. Acquire required knowledge and practical skills in wood cutting, joining and other allied operations.</li> <li>3. Acquire required knowledge and practical skills in engineering measurements.</li> </ol> |

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|                                                                                                                                                                                                                                                                                                                                                                                                                         | 4. Acquire experience in preventive and corrective maintenance of various cutting tools, machine tools and equipment.<br>5. Acquire required knowledge and practical skills in fabrication techniques<br>6. Finish various jobs within specified time and resource limits, with proper measurements and evaluate them by appropriate methods and tools. |
| <b>Topics Covered</b>                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                         |
| <b>Unit – I</b>                                                                                                                                                                                                                                                                                                                                                                                                         | <b>6</b>                                                                                                                                                                                                                                                                                                                                                |
| <b>Introduction to Carpentry:</b> Need for the work, training, relationship between timber, tools and carpentry. Carpentry tools: classification of tools; measuring & making; holding; cutting; grooving; planning; striking; boring and miscellaneous tools; care and maintenance of tools; wood working machines; wood working lathe; wood sawing machine.                                                           |                                                                                                                                                                                                                                                                                                                                                         |
| <b>Unit – II</b>                                                                                                                                                                                                                                                                                                                                                                                                        | <b>6</b>                                                                                                                                                                                                                                                                                                                                                |
| <b>Types of work and working procedure:</b> Marking, sawing, planning, chiselling, boring, striking, checking, sharpening; joints in carpentry work; nails, screws and other materials; finishing work.                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                         |
| <b>Unit – III</b>                                                                                                                                                                                                                                                                                                                                                                                                       | <b>6</b>                                                                                                                                                                                                                                                                                                                                                |
| <b>General Fabrication Concepts:</b> Introduction to fabrication; material properties: metals, semi-conductors and polymers; design and planning: principles of design, blueprint reading, and creating fabrication plans; safety and standards.                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                         |
| <b>Unit – IV</b>                                                                                                                                                                                                                                                                                                                                                                                                        | <b>6</b>                                                                                                                                                                                                                                                                                                                                                |
| <b>Fabrication Processes:</b> Cutting: various cutting methods like, laser, plasma, water jet, and mechanical shears; forming: techniques for shaping metal, bending, rolling, and stamping; welding and joining: different welding methods, soldering, brazing and adhesive bonding; finishing: surface treatments like painting, plating and polishing.                                                               |                                                                                                                                                                                                                                                                                                                                                         |
| <b>List of Experiments – Carpentry</b> <ol style="list-style-type: none"> <li>1. To prepare Half Lap Joint.</li> <li>2. To make a simple Mortise and Tenon joint.</li> <li>3. To make a Mortise Tenon joint 45 Deg.</li> <li>4. To make a Habed or Lap DoveTail Joint.</li> <li>5. To make a Common Multiple Joint.</li> </ol>                                                                                          |                                                                                                                                                                                                                                                                                                                                                         |
| <b>List of Experiments – Fabrication</b> <ol style="list-style-type: none"> <li>1. Manual Metal Arc Welding/ Shielded Metal Arc Welding</li> <li>2. Gas Metal Arc Welding</li> <li>3. Friction Stir Welding</li> <li>4. Mold Preparation, Melting and Casting</li> </ol>                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                         |
| <b>Textbooks:</b> <ol style="list-style-type: none"> <li>1. S. N. Pophale and A. K. Goel, Carpentry and woodwork, Railway Engineering Technical Society, Pune, 2008.</li> <li>2. Willis H Wagner, Howard Bud Smith, and Mark W Huth, Modern Carpentry, Goodheart-Wilcox Publications, 12<sup>th</sup> Edn., 2015.</li> </ol> R L Agarwal and Tahil Manghnani, Welding Engineering, Khanna Publishers, Fifht Edn., 1991. |                                                                                                                                                                                                                                                                                                                                                         |

### Skill-Based Courses to Qualify for UG Diploma (Engg.) in Civil Engineering

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| <b>BCE 264</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>INTRODUCTION TO REMOTE SENSING AND GIS</b>                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Course Category</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Minor                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Contact hours/week</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Lecture – 3; Tutorial – 0; Practical – 2                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Number of credits</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Course assessment methods</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Continuous assessment through attendance, home assignments, quizzes, two minor practical exam and One Major Practical Examination                                                                                                                                                                                                                                                                                                                       |
| <b>Course Objectives</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 1. To introduce the student to the physical principles of Remote Sensing and image interpretation as a tool for mapping.<br>2. To provide exposure to fundamental data models and data structures in GIS<br>3. To introduced principle of GPS, It's components, signal structure, and working procedure                                                                                                                                                 |
| <b>Course Outcomes</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | At the end of the course student will be able to:<br>1. Select the type of remote sensing data for mapping earth surface features<br>2. Identify the earth surface features from satellite images<br>3. Analyse the basic components of GIS<br>4. Classify the maps, coordinate systems and projections<br>5. Process spatial and attribute data and prepare thematic maps<br>6. Apply remote sensing & GIS techniques for natural resources evaluation |
| <b>Topics Covered</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Unit – I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Fundamentals of GIS:</b> Information Systems, Modelling Real World Features Data, Data Models – Spatial and Non-spatial, Components, Data Collection and Input, Data Conversion, Metadata<br><b>Database Management:</b> Database Structures, Files; Standard Data Formats, Compression Techniques, Hardware and Software.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Unit – II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Principles of Remote Sensing:</b> Concept of remote sensing; principles of electromagnetic radiation; characteristics of remotely sensed data; remote sensing data interpretation and analysis<br><b>Geo-referencing:</b> Place names; linear referencing systems; cadasters; measuring the earth latitude and longitude; projections and coordinates; measuring latitude, longitude and elevation using GPS; converting geo-references                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Unit – III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>GIS data collection:</b> Primary geographic data capture; secondary geographic data capture; obtaining data from external sources; capturing attribute data.<br><b>Cartography and map production:</b> maps and cartography; principles of map design; map series; applications                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Unit – IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Different map projections; spatial interpolation techniques; DEM and different types of resolutions; quality assessment of freely available DEMs; overlaying operations; buffer analysis; classification methods; errors in GIS; key elements of maps; limitations of GIS<br>List of Practical exercises for <b>Remote sensing and GIS</b> course <ol style="list-style-type: none"> <li>1. Introduction to GIS and QGIS- Downloading and installing QGIS, Introduction to QGIS interface and layers, and Plugin management in QGIS (e.g., OpenLayers, QuickMapServices)</li> <li>2. Introduction to handheld GPS devices, Field data collection, Exporting GPS data to GIS, Coordinate systems overview, and UTM conversion using QGIS.</li> <li>3. Remote Sensing Data: Introduction and Acquisition, Basics of remote sensing, Types of satellite data (Landsat, Sentinel, etc.) and downloading satellite data from: USGS Earth Explorer and Bhuvan Portal.</li> <li>4. Data Conversion- Vector and raster data types, and Conversion between data formats.</li> </ol> |                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

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| <ol style="list-style-type: none"> <li>To carry out image rectification and Geo-referencing using QGIS and geo-referenced layers</li> <li>To create new vector layers, digitizing features (points, lines, and polygons), Using snapping and topology tools and Attribute data entry during digitization.</li> <li>To editing attribute tables, using field calculator, Selection by location and attributes</li> <li>To learn DEM elevation data, Downloading DEMs (SRTM), Slope, aspect, and hill shade generation, Contour extraction and watershed analysis.</li> <li>To carry out raster data analysis, Raster calculator for map algebra, and Vegetation indices (NDVI).</li> <li>Supervised classification using Semi-Automatic Classification Plugin (SCP).</li> <li>Unsupervised classification using Semi-Automatic Classification Plugin (SCP).</li> </ol> |
| <b>Textbooks</b> <ol style="list-style-type: none"> <li>Introduction to Remote Sensing, James B. Campbell &amp; Randolph H. Wynne., The Guilford Press, 2011.</li> <li>Introduction to the physics and techniques of Remote Sensing, Charles Elach&amp; Jakob van Zyl., John Wiley &amp; Sons publications, 2006.</li> <li>Remote Sensing and Image Interpretation, Lillesand T.M &amp; Kiefer R.W., John Wiley and Sons, 2015</li> <li>Geographic Information systems and Science, Paul Longley., John Wiley &amp; Sons, 4th Edition, 2015.</li> <li>Introduction to Geographic Information Systems, 9th Edition, Kang Tsung Chang., Tata Mc Graw Hill Publishing Company Ltd, New Delhi, 2018.</li> </ol>                                                                                                                                                           |

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| <b>BCE 265</b>                   | <b>ANALYSIS AND DESIGN OF WATER DISTRIBUTION SYSTEMS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |          |
| <b>Course Category</b>           | Skill-based courses                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |          |
| <b>Contact hours/week</b>        | Lecture – 3; Tutorial – 0; Practical – 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |          |
| <b>Number of credits</b>         | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |          |
| <b>Course assessment methods</b> | Continuous assessment through attendance, home assignments, quizzes, two minor practical exam and One Major Practical Examination                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |          |
| <b>Course Objective</b>          | To provide a thorough theoretical and practical knowledge in water distribution systems using which a student can solve real world problems concerning with design and analysis of pipe network distributions.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |          |
| <b>Course Outcomes</b>           | 1. Develop water distribution systems with a thorough understanding of hydraulic principles and system components.<br>3. Perform calculations and solve problems commonly encountered in water distribution systems, such as volumes, flow rates, velocities, pressures, and chemical dosage<br>4. Evaluate existing systems to identify inefficiencies and implement effective solutions.<br>5. Apply industry-standard design standards to create efficient and reliable water distribution networks.<br>6. Use EPANET2 software to model, analyze, and optimize water distribution systems.<br>7. Design comprehensive water systems at the sub-division level, addressing both hydraulic and quality considerations. |          |
| <b>Topics Covered</b>            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |          |
| <b>Unit – I</b>                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>9</b> |



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| <b>Introduction to pipe networks:</b> Types of networks: serial, branching, and looped; parameters; labelling network elements: branching and looped networks; parameters interrelationships: pipe head loss relationship, node flow continuity relationship, loop head loss relationship; rules for solvability of pipe networks: rules proposed by Shamir and Howard; rules proposed by Goffman and Rodeh; rules proposed by Bhawe; comparison of rules |          |
| <b>Unit – II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>9</b> |
| <b>Formulation of equations:</b> states of parameters; basic unknown parameters; single source and multi-source networks with known pipe resistances: branching and looped networks; networks with unknown pipe resistances: branched and looped; inclusion of pumps: supply and booster; inclusion of check valves: in an external pipe, in an internal pipe, in several pipes; inclusion of pressure reducing valves                                    |          |
| <b>Unit – III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>9</b> |
| <b>Hardy-Cross Method:</b> Method of balancing heads; method of balancing flows; modified Hardy-Cross method; selection of initial values; convergence problems<br><b>Newton-Raphson Method:</b> Basic concepts; head equations; loop equations; labelling network elements<br><b>Linear theory method:</b> pipe discharge equations; nodal head equations; relationship between Newton-Raphson and linear theory method                                  |          |
| <b>Unit – IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>9</b> |
| <b>Dynamic Analysis:</b> Iterative method; direct method. Node flow analysis: two node serial network; node classification; NFA theory. Calibration: data collection and preparation; calibration methods; practical considerations                                                                                                                                                                                                                       |          |
| <b>Textbooks</b>                                                                                                                                                                                                                                                                                                                                                                                                                                          |          |
| 1. Pramod R Bhawe, Analysis of flow in water distribution networks, Technomic Publications, 2004.<br>2. Lewis A Rossman, EPANET 2 User Manual, 2000                                                                                                                                                                                                                                                                                                       |          |
| <b>List of Practical Experiments</b><br>1. Quick start tutorial<br>2. Preparing physical and non-physical components of network models<br>3. Understanding EPANET's workspace<br>4. Working with projects<br>5. Working with objects<br>6. Working with the map<br>7. Analyzing a network<br>8. Viewing results<br>9. Printing and copying<br>10. Importing and exporting files                                                                           |          |

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| <b>BCE 266</b>                   | <b>GEOTECHNICAL EXPLORATION AND INSTRUMENTATION</b>                                                                                                                                  |
| <b>Course category</b>           | Skill-based courses                                                                                                                                                                  |
| <b>Pre-requisite Subject</b>     | NIL                                                                                                                                                                                  |
| <b>Contact hours/week</b>        | Lecture: 3, Tutorial: 0 , Practical: 2                                                                                                                                               |
| <b>Number of Credits</b>         | 4                                                                                                                                                                                    |
| <b>Course Assessment Methods</b> | Continuous assessment through attendance, home assignments, quizzes, practical work, record, viva voce and One Minor test and One Major Theory Examination and Practical Examination |

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| <b>Course Objectives</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <p>The objectives of the course are as follows:</p> <ol style="list-style-type: none"> <li>1. To Understand the types of soil and develop various applications of soil as a construction material for civil engineering structures.</li> <li>2. To Evaluate the soil quality to understand the basic relationships between physical and mechanical properties of soils.</li> <li>3. To understand the soil testing methods as the basic knowledge of classification and engineering properties of soil</li> <li>4. To understand the different ground modification methods and the experimental methods for laboratory as well as field investigations.</li> </ol>                                             |
| <b>Course Outcomes</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <p>After completion of this course the students to demonstrate following knowledge, skills and attitudes.</p> <ol style="list-style-type: none"> <li>1. Comprehend the basics of site investigation methods and field tests and its extent for variety of structures including preliminary investigations.</li> <li>2. Identify and suitable investigation method for soil exploration.</li> <li>3. Illustrate different specialized exploration methods based on condition and requirement.</li> <li>4. Appraise different codal provisions for field tests.</li> <li>5. Basic knowledge about soil explorations and field investigations.</li> <li>6. Learn to prepare soil investigation report.</li> </ol> |
| <b>Topics Covered</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>UNIT-I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <p>Interpretations and Codal Provisions: Soil profiling, interpretation of exploration data and report preparation, various standards for soil investigations. direct, semi-direct, and indirect methods of soil investigations, Purpose and Phases of Soil Investigation.</p> <p>Report writing: Soil exploration Reports- identification, calculations and preparation.</p>                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>UNIT-II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <p>Exploration Methods: Methods of Boring, Augering and Drilling. Machinery used for drilling, types of augers and their usage for various projects.</p> <p>Soil Sampling: sampling methods, types of samples, storage of samples and their transport. Sample preparation, sample sizes, types of samplers specifications for soil testing. Trial pits, disturbed and undisturbed sampling</p> <p>Detailed bore hole investigations: types of borings and types of samplers. Compaction: Standard and Modified Proctor compaction tests; field compaction; Proctor Needle Test. Consolidation test.</p> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>UNIT-III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <p>Geophysical Investigations: Introduction to geophysical methods, Seismic Refraction Test: Principles and applications, MASW (Multichannel Analysis of Surface Waves) and SASW (Spectral Analysis of Surface Waves) methods, Electrical resistivity test: Principles, methods, and applications, Ground-penetrating radar (GPR) and magnetic surveys, Seismic Refraction methods.</p>                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>UNIT-IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <p>Field Tests: Methods and specifications – visual identification tests, vane shear test, penetration tests, analysis of test results.</p> <p>Field Instrumentation: Rollers, Pressure meters, Piezometer, Pressure cells, Sensors, Inclometers, Strain gauges etc.</p> <p>Plate load test, pile load test, SPT test, CPT test, flat dilatometer test, DCPT test, Vane shear test, pressure meter test, field CBR test, core cutter, sand replacement test.</p>                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>List of Experiments</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <ol style="list-style-type: none"> <li>1. (i) Insitu Density by Core Cutter Method<br/>(ii) Insitu Density by Sand Replacement Method</li> <li>2. Methods of Boring and Field Sampling</li> <li>3. Standard Penetration Test (SPT)</li> </ol>                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

4. Static Cone Penetration Test (SCPT)
5. Dynamic Cone Penetration Test (DCPT)
6. Plate Load Test
7. Pile Load Test
8. Vane Shear Test
9. Field CBR
10. Geophysical Exploration Methods

#### **Textbooks**

- Alam Singh – Modern Geotechnical Engineering, Asia Publishing House, New Delhi.
- Gopal Ranjan and A.S.R. Rao – Basic and Applied Soil Mechanics, New Age International (P) Ltd.
- B.C. Punamia – Soil Mechanics and Foundations, Laxmi Publications (P) Ltd.
- C. Venkataramaiah – Geotechnical Engineering, New Age International (P) Ltd., New Delhi.

#### **Reference Books**

- Schnaid, F. (2009) In Situ Testing in Geomechanics : The Main Tests. Taylor & Francis.
- J. E. Bowles, “Foundation Analysis and Design”, McGraw Hill Companies, 1997.
- M. D., Desai, “Ground Property Characterization from In-Situ Testing”, Published by IGS-Surat Chapter, 2005.
- M. J., Hvorslev, “Sub-Surface Exploration and Sampling of Soils for Civil Engineering Purposes”, US Waterways Experiment Station, Vicksburg, 1949.
- Robert M. Koerner “Construction and Geotechnical methods in Foundation Engineering”, Mc.Graw-Hill Pub. Co., New York, 1985.
- Manfred R. Haussmann, “Engineering principles of ground modification”, Pearson Education Inc. New Delhi, 2008.
- F. G., Bell, “Engineering Treatment of Soils”, E& FN Spon, New York, 2006.
- P. Purushothama Raj, “Ground Improvement Techniques” Laxmi Publications (P) Limited, 2006.
- Jie Han et. al., “Advances in ground Improvement” Allied Pub., 2009.
- Hunt Roy E , Geotechnical Investigation Methods, A Field Guide for Geotechnical Engineers, Taylor & Francis Ltd.

### Skill Based Courses to Qualify for B. Voc. (Engg.) Course in Civil Engineering

|                                                                                                                                                                                                                                                                                                                                                                      |                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>BCE 357</b>                                                                                                                                                                                                                                                                                                                                                       | <b>PAVEMENT DESIGN USING SOFTWARES</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Course category</b>                                                                                                                                                                                                                                                                                                                                               | :                                      | Skill Enhancement Course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Pre-requisite Subject</b>                                                                                                                                                                                                                                                                                                                                         | :                                      | NIL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Contact hours/week</b>                                                                                                                                                                                                                                                                                                                                            | :                                      | Lecture:2, Tutorial:0, Practical:2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Number of Credits</b>                                                                                                                                                                                                                                                                                                                                             | :                                      | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Course Assessment methods</b>                                                                                                                                                                                                                                                                                                                                     | :                                      | Continuous assessment through attendance, home assignments, quizzes, and One Minor Test and One Major Theory and Practical Examination.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Course Objectives</b>                                                                                                                                                                                                                                                                                                                                             | :                                      | To enable students to utilize pavement design software in alignment with relevant codal provisions.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Course Outcomes</b>                                                                                                                                                                                                                                                                                                                                               | :                                      | <p>The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course</p> <ol style="list-style-type: none"> <li>7. Explain flexible and rigid pavement design principles as per IRC.</li> <li>8. Ability to perform flexible pavement thickness design using IITPAVE</li> <li>9. Capability to analyse stress and strain responses in pavement layers</li> <li>10. Skill to interpret software outputs for design decisions</li> <li>11. Understanding of mechanistic–empirical pavement design framework</li> <li>12. Ability to compare different pavement alternatives using computational tools</li> </ol> |
| <b>Topics Covered</b>                                                                                                                                                                                                                                                                                                                                                |                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>UNIT I</b>                                                                                                                                                                                                                                                                                                                                                        |                                        | <b>6</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Types of pavements: flexible, rigid and composite pavements; Design philosophies as per IRC pavement design guidelines (IRC:37, IRC:58); Introduction to IITPAVE software: interface, input parameters and output interpretation; Pavement material characterization: resilient modulus, Poisson's ratio, elastic modulus                                            |                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>UNIT II</b>                                                                                                                                                                                                                                                                                                                                                       |                                        | <b>6</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Flexible Pavement Design using IITPAVE: Layered elastic theory and stress–strain response in pavements; Traffic loading and axle load spectrum; Design inputs: traffic, subgrade CBR, layer properties; Fatigue and rutting criteria as per IRC:37; Thickness design and performance analysis using IITPAVE; Sensitivity analysis on traffic and material properties |                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>UNIT III</b>                                                                                                                                                                                                                                                                                                                                                      |                                        | <b>6</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Fundamentals of rigid pavement design: Westergaard's theory, Stresses in concrete pavements (edge, corner and interior stresses), Design parameters: modulus of subgrade reaction, temperature stresses, load transfer                                                                                                                                               |                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>UNIT IV</b>                                                                                                                                                                                                                                                                                                                                                       |                                        | <b>6</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Advanced Pavement Analysis Tools: Mechanistic–empirical pavement design concepts, Reliability, drainage and climatic factors in pavement design, Introduction to other pavement design software, Case studies on pavement design optimization using software                                                                                                         |                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

**List of experiments**

Module 1: Installation and familiarization with pavement design software including interface and workflow.

Module 2: Determination of effective subgrade CBR and resilient modulus for mechanistic design input.

Module 3: Design and analysis of bituminous pavement with granular base and sub-base using software.

Module 4: Design and analysis of bituminous pavement with GSB and cement treated base (CTB).

Module 5: computation of Cumulative Fatigue Damage in Cement Treated Base (CTB) layer for Single Axles

Module 6: computation of Cumulative Fatigue Damage in CTB Layer for Tandem axles

Module 7: computation of Cumulative Fatigue Damage in (CTB) Layer for Tridem Axles

Module 8: Design and evaluation of flexible pavement with cement treated sub-base (CTSB) and CTB layers.

Module 9: Design and analysis of flexible pavement with dry lean concrete (DLC) sub-base and CTB.

Module 10: Design of bituminous pavement using RAP treated with foamed bitumen or emulsion and cemented sub-base.

**Textbooks**

1. Khanna, S. K. and Justo, C. e. G., Highway Engineering, Nemchand Bros., Roorkee
2. Huang, Y. H., Pavement analysis and Design. Prentice Hall, Englewood Cliffs, New Jersey

**Reference books**

7. Yoder and Whitejack, Pavement Design, John Wiley & Sons.
8. Flaherty, O. Highways-Location Design, Construction and Maintenance of Pavements, Taylor and Francis.
9. Rajib B. Mallick and Tahar El-Korchi - Pavement Engineering: Principles and Practice.
10. IRC: 37-2001, "Guidelines for the Design of Flexible Pavements (Second Revision)".
11. IRC: 58-2001, "Guidelines for the Design of Plain Jointed Rigid Pavements for Highways (Second Revision)".
12. AASHTO – Design of pavement Structures

|                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>BCE 358</b>                   | <b>SOFTWARE APPLICATION FOR BUILDING DESIGN</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Course Category</b>           | Skill Enhancement Course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Pre-requisite Subject</b>     | NIL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Contact Hours/Week</b>        | Lecture: 2, Tutorial: 0 , Practical: 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Number of Credits</b>         | 03                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Course Assessment Methods</b> | Continuous assessment through attendance, home assignments, quizzes, and One Minor Test and One Major Theory and Practical Examination.                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Course Objectives</b>         | To introduce the fundamentals of computer-based structural analysis and design for building systems and to familiarize students with practical issues related to structural modeling, error identification and validation of analysis results.                                                                                                                                                                                                                                                                                   |
| <b>Course Outcomes</b>           | After completion of this course, students will be able to: <ol style="list-style-type: none"> <li>1. Develop 2D and 3D structural models using STAAD Pro with appropriate material and section properties.</li> <li>2. Apply different types of loads, define load cases and prepare load combinations in STAAD Pro.</li> <li>3. Perform structural analysis and interpret reactions, shear forces, bending moments and displacements.</li> <li>4. Model and analyze building frames under gravity and lateral loads.</li> </ol> |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                         |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 5. Analyze truss and arch structures and evaluate structural behavior under different loading conditions.<br>6. Validate and interpret structural analysis results for building design. |
| <b>Topics Covered</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                         |
| <b>UNIT-I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                         |
| Introduction to structural modeling in STAAD Pro environment. Definition of units, grid system and coordinate system. Modeling of basic structural components such as beams, slabs and columns. Assignment of material properties, section properties and support conditions. Development of simple two-dimensional structural models.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                         |
| <b>UNIT-II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                         |
| Modeling of structural elements and assignment of boundary conditions in STAAD Pro. Application of dead and live loads on structural members. Definition of load cases and preparation of load combinations. Execution of structural analysis and study of reactions, shear force, bending moment and displacement results.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                         |
| <b>UNIT-III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                         |
| Modeling of building frames including multi-storey beam-column systems in STAAD Pro. Application of dead, live and lateral loads on building structures. Analysis of complete building models and interpretation of internal forces and storey displacements. Assessment of structural behavior under combined loading conditions.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                         |
| <b>UNIT-IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                         |
| Modeling of truss and arch structures in STAAD Pro. Assignment of loading and support conditions. Structural analysis under different load combinations and interpretation of analysis results within the software environment.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                         |
| <b>List of Experiments</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                         |
| 1. Analysis of a simply supported beam and study of reactions, shear force and bending moment diagram.<br>2. Analysis of a cantilever beam and study of deflection and bending moment.<br>3. Analysis of a continuous beam and comparison of internal forces under different loading cases.<br>4. Analysis of a 2D portal frame and study of displacement and bending moment distribution.<br>5. Analysis of a multi-bay frame and comparison of storey deflection.<br>6. Modeling and analysis of a single-storey building frame under dead and live loads.<br>7. Modeling and analysis of a two-storey building frame and evaluation of storey drift.<br>8. Analysis of a 2D truss and determination of axial forces in members.<br>9. Analysis of a simple 3D frame structure and evaluation of nodal displacements.<br>10. Analysis of a two-hinged arch and study of support reactions and horizontal thrust. |                                                                                                                                                                                         |
| <b>Text Books</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                         |
| Hibbeler, R. C., Structural Analysis, 10th ed., Pearson Education.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                         |
| McGuire, W., Gallagher, R. H. & Ziemian, R. D., Matrix Structural Analysis, John Wiley & Sons.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                         |
| <b>Reference Books</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                         |
| Kassimali, A., Structural Analysis, 5th Edition, Cengage Learning, 2018.a                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                         |
| Weaver, W. and Gere, J. M., Matrix Analysis of Framed Structures, CBS Publishers & Distributors.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                         |
| IS 456: 2000, Plain and Reinforced Concrete – Code of Practice, Bureau of Indian Standards, New Delhi.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                         |
| IS 800: 2007, General Construction in Steel – Code of Practice, Bureau of Indian Standards, New Delhi.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                         |

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|-----------------------|----------------------------------------------------------|
| <b>BCE 359</b>        | <b>SOFTWARE APPLICATIONS IN GEOTECHNICAL ENGINEERING</b> |
| Course category       | : Skill Enhancement Course                               |
| Pre-requisite Subject | : NIL                                                    |
| Contact hours/week    | : Lecture: 2, Tutorial:0, Practical: 2                   |
| Number of credits     | : 3                                                      |

|                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|---------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Course Assessment Methods | : Continuous assessment through practicals, attendance, home assignments, quizzes, record, minor tests, and one Major Theory Examination.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Course Objectives         | : To develop competency in numerical modelling and software-based analysis of geotechnical engineering problems using professional tools.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Course Outcomes           | : After completion of the course, students will be able to: <ol style="list-style-type: none"> <li>1. Understand numerical modelling concepts and geotechnical software fundamentals.</li> <li>2. Develop computational models with appropriate geometry, mesh and soil parameters.</li> <li>3. Analyse bearing capacity and settlement of shallow foundations using software tools.</li> <li>4. Evaluate slope stability and seepage behaviour through numerical analysis.</li> <li>5. Model retaining structures, excavations and soil–structure interaction problems.</li> <li>6. Interpret results and validate numerical solutions with classical geotechnical theory.</li> </ol> |

### Topics Covered

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |   |
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| <b>UNIT-I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 6 |
| Introduction to numerical modelling in geotechnical engineering and overview of finite element and limit analysis approaches. Basic modelling workflow including geometry creation, meshing, boundary conditions, loading conditions and selection of appropriate soil constitutive models based on laboratory and field data.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |   |
| <b>UNIT-II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 6 |
| Analysis of soil and foundation problems including bearing capacity and settlement of shallow foundations, stress distribution in soil mass and basic soil–structure interaction modelling. Parametric studies to assess the influence of soil strength and stiffness parameters on foundation response.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |   |
| <b>UNIT-III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 6 |
| Numerical modelling of slope stability and seepage problems, evaluation of factor of safety, identification of failure mechanisms and influence of pore water pressure on slope behaviour. Coupled seepage–stability analysis for slopes and earth structures.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |   |
| <b>UNIT-IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 6 |
| Analysis of earth retaining structures and excavations using numerical techniques, including staged construction and reinforced soil concepts. Introductory modelling of seismic response and interpretation, and validation.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |   |
| <b>Practical Experiments:</b> <ol style="list-style-type: none"> <li>1. Introduction to geotechnical software interface, setup, geometry and meshing techniques.</li> <li>2. Modelling of shallow foundation for bearing capacity and settlement estimation.</li> <li>3. 1-Dimensional consolidation of the clay material.</li> <li>4. Slope stability analysis using limit equilibrium and finite element analysis.</li> <li>5. Seepage analysis of the earthen dam</li> <li>6. Stability and deformation analysis of retaining structures.</li> <li>7. Braced excavation analysis with staged construction considering soil–structure interaction.</li> <li>8. Slope stabilization analysis using soil nailing and geosynthetic reinforcement techniques.</li> <li>9. Evaluation of earthquake-induced failure mechanism of slopes.</li> <li>10. Bearing capacity and load-settlement analysis of the foundation resting over reinforced earth beds.</li> </ol> |   |

**Text Books:**

1. Brinkgreve, R.B.J., Kumarswamy, S., Swolfs, W.M., *Finite Element Method in Geotechnical Engineering*, CRC Press.
2. Das, B.M., *Principles of Foundation Engineering*, Cengage Learning.
3. Griffiths, D.V. and Lane, P.A., *Slope Stability Analysis by Finite Elements*, Thomas Telford.

**Reference Books:**

1. Potts, D.M. and Zdravković, L., *Finite Element Analysis in Geotechnical Engineering*, Thomas Telford.
2. Smith, I.M., Griffiths, D.V., and Margetts, L., *Programming the Finite Element Method*, Wiley.
3. GeoStudio User Manual, Geo-Slope International Ltd.
4. OptumG2 Reference Manual, Optum Computational Engineering.
5. Duncan, J.M. and Wright, S.G., *Soil Strength and Slope Stability*, Wiley.

**Syllabus of Audit Courses****CONSTITUTION OF INDIA**

**Course Code:** : **AUC 101** **Credits (0-0-0)**

**Course Category** : **Audit**

**Pre-requisite Subject** : **NIL**

**Contact Hours/Week** : **1/2 Lecture : , Tutorial : , Practical:**

**Number of Credits** : **0 Credit**

**Course Assessment Methods:** Continuous assessment through tutorials, attendance, home assignments, quizzes, practical, Tutorial class, viva voce and Minor tests and One Major Theory Examination.

**Course Outcomes:**

At the end of the course, learners should be able to

CO1- Student will Identify and explore the basic features and modalities about Indian constitution

CO2- Students will be able to differentiate and relate the functioning of Indian parliamentary system at the center and state level.

CO3- Student will be able to differentiate different aspects of Indian Legal System and its related bodies.

**UNIT 1**--Introduction and Basic Information about Indian Constitution: Historical Background of the Constituent Assembly, The Preamble of the Constitution, Fundamental Rights, Fundamental Duties, Directive Principles of State Policy, Parliamentary System, Federal System.

**UNIT 2**-Union Executive and State Executive: Powers of Indian Parliament Functions of Rajya Sabha, Functions of Lok Sabha, Powers and Functions of the President, Powers and Functions of the Prime Minister, Judiciary.

**UNIT 3**- Introduction and Basic Information about Legal System: The Court System in India and Foreign Courtiers (District Court, District Consumer Forum, Tribunals, High Courts, Supreme Court).

**UNIT 4**- Intellectual Property Laws and Regulation to Information: Introduction, Legal Aspects of Patents, Filing of Patent Applications, Rights from Patents, Infringement of Patents, Copyright, Information Technology Act, 2000. The Company's Act:

**Reference:**



- 1) G. Austin (2004) Working of a Democratic Constitution of India, New Delhi: Oxford University Press.
- 2) Basu, D.D (2005), An Introduction to the Constitution of India, New Delhi, Prentice Hall.
- 3) N. Chandhoke & Priyadarshini (eds) (2009) Contemporary India: Economy, Society, Politics, New Delhi: Oxford University Press.
- 4) N.G Jayal and P.B. Maheta, (eds) (2010) Oxford Companion to Indian Politics, New Delhi: Oxford University Press.

### **Indian Culture and Heritage**

**Course Code:** : **AUC 102** **Credits (0-0-0)**  
**Course Category** : **Audit**  
**Pre-requisite Subject** : **NIL**  
**Contact Hours/Week** : **1/2 Lecture : , Tutorial : , Practical:**  
**Number of Credits** : **0 Credit**  
**Course Assessment Methods:** Continuous assessment through tutorials, attendance, home assignments, quizzes, practical, Tutorial class, viva voce and Minor tests and One Major Theory Examination.

#### **Unit-I**

Indian Culture: An Introduction, Characteristics of Indian culture, Significance of Geography on Indian Culture, Society in India, Religion and Philosophy in India.

#### **Unit-II**

Indian Languages and Literature, Evolution of script and languages in India, Harappan Script and Brahmi Script, History of Buddhist and Jain Literature.

#### **Unit-III**

A Brief History of Indian Arts and Architecture, Indian Art & Architecture: Gandhara School and Mathura School of Art; Hindu Temple Architecture, Buddhist Architecture, Medieval Architecture and Colonial Architecture. Indian Painting Tradition: ancient, medieval, modern Performing Arts: Divisions of Indian classical music: Hindustani and Carnatic, Dances of India: Various Dance forms: Classical and Regional, Rise of modern theatre and Indian cinema.

#### **Unit-IV**

Spread of Indian Culture Abroad, Causes Significance and Modes of Cultural Exchange - Through Traders, Teachers, Emissaries, Missionaries and Gypsies, Indian Culture in South East Asia, India, Central Asia and Western World.

#### **Recommended Readings:**

1. Barua, B. 1934-37. Barhut Vol. I-III. Calcutta: Indian Research Institute.
2. Cunningham, Alexander 1966. The Bhilsa Topes. Varanasi: Indological Book Corporation.
3. Cunningham, Alexander 1965. The Stupa of Bharhut. Varanasi: Indological Book Corporation.
4. Dallapiccola, L.S.Z. Lallemant. 1980. The Stupa : Its Religious, Historical, and Architectural Significance. Wiesbaden: Franz Steiner Verlag.
5. Dehejia, Vidya 1972. Early Buddhist Rock Temples A Chronological Study. London: Thames and Hudson

## Indian Architecture

**Course Code:** : AUC 103 **Credits (0-0-0)**

**Course Category** : **Audit**

**Pre-requisite Subject** : NIL

**Contact Hours/Week** : 1/2 Lecture : , Tutorial : , Practical:

**Number of Credits** : 0 Credit

**Course Assessment Methods:** Continuous assessment through tutorials, attendance, home assignments, quizzes, practical, Tutorial class, viva voce and Minor tests and One Major Theory Examination.

### Course outcomes

CO1- This course will help student learn about the development of Indian architecture and its contextual and traditional aspects.

CO2- The learner will gain knowledge of the development of architectural forms with reference to technology, style and character in various aspects of Hindu architecture.

CO3- The students will comprehend and relate to the theoretical basis of Buddhist and Jain Architectures.

**UNIT 1;** Indus Valley Civilization: Town planning principles, cultural ethos, economy exemplified. The Aryan civilization: With its emphasis on the Vedic town plan.

**UNIT 2:** Buddhist Architecture Typology of stupa, edicts, stupas, viharas, and chaityas, both in rock-cut or other wise. The Buddhist philosophy and its imprint

**UNIT3;** Hindu Architecture, Indo Aryan: The evolution of the temple form, evolution of the shikhara in north India. The three schools of architecture - the Gujarat, the Khajuraho, and the Orissan styles, Introduction to Dravidian Hindu Architecture.

**UNIT 4:** Jain Architecture : The temple cities of Palitana, Mount Abu and Girnar. Jain Theory The Jain philosophy and its imprint in built form.

### REFERENCE BOOKS

1. Stella Kramrisch, The Hindu temple, Volume 1 & 2, Motilal Banarsidass Publications, 1996.
2. Percy Brown, Indian Architecture (Buddhist and Hindu period), D.B.Taraporewala Sons & co Pvt. Ltd. 1965
3. Volwahren, Andreas, Living Architecture
4. Satish Grover, The Architecture of India- Volume 2, Vikas, 1980.
5. Henri Stierlin, Anne Stierlin, Hindu India: from Khajuraho to the temple city of Madurai, Taschen, 1998.
6. James Fergusson, History of Indian & Eastern Architecture, 2007
7. C. Batley, Design Development of Indian Architecture, John murray, London, 1934.

## Indian Festivals

**Course Code:** : AUC 104 **Credits (0-0-0)**

**Course Category** : **Audit**

**Pre-requisite Subject** : NIL

**Contact Hours/Week** : ½ Lecture : , Tutorial : , Practical:

**Number of Credits** : 0 Credit

**Course Assessment Methods:** Continuous assessment through tutorials, attendance, home assignments, quizzes, practical, Tutorial class, viva voce and Minor tests and One Major Theory Examination.

**Course Outcomes:**

CO1-Students will learn about rich cultural aspects associated with Indian religions

CO2-The course will give deep insight in to understand the importance of festivals.

**UNIT 1; Indian Festivals:** Introduction to major Indian festivals Bihu, Raksha Bandhan , Onam, Pongal, Holi, Dipawali, Dushehra, Easter, Good Friday, Christmas , Eid-ul-fitr and Eid-ul-Azha , Cultural aspects of festivals .

**UNIT 2 ; Characteristics of Indian festivals** ; Seasonal in nature, seasonal festival are Agro based, worships of animals.

**UNIT 3;** festivals observed at same time but with different names in different parts of country.

**UNIT3 :** Artificial or non religious festivals- like Jaisalmer desert festivals, Mango festivals in Delhi, Elephant festivals in India. Etc.

**REFERENCE BOOKS**

- 1) Discover India; Festival of India by Sonia Mehta
- 2) Hindu Festival : Origin, sentiments and Rituals by Mukuncharan Das.

**VAIDIC MATHEMEATICS**

**Course Code:** : **AUC 105** **Credits (0-0-0)**

**Course Category** : **Audit**

**Pre-requisite Subject** : **NIL**

**Contact Hours/Week** : **1/2 Lecture : , Tutorial : , Practical:**

**Number of Credits** : **0 Credit**

**Course Assessment Methods:** Continuous assessment through tutorials, attendance, home assignments, quizzes, practical, Tutorial class, viva voce and Minor tests and One Major Theory Examination.

**Course outcomes:**

- Vedic mathematics methods are used in coding and VLSI implementation of encryption.
- Vedic mathematics method of division, exponentiation and multiplication are used in internet security and cryptographic algorithms for making these calculations faster than before.
- Arithmetic and logic unit (ALU) is responsible for all mathematical and logical calculations in computers. Some sutras like udharvtriyakbhyam and nikhilam are used for implementing multiplication methods.
- Digital Signal Processing (DSP) includes face recognition, text speech conversion, image processing and audio -video processing and also filtering of noise. In this area VM methods are very useful to improve the performance of DSP algorithms.

**UNIT-I**

Introduction & history of Vedic mathematics, Arithmetic and number, Vedic Maths Formulae, Addition and Subtraction: Addition - Completing the whole , Addition from left to right , Addition of list of

numbers - Shudh method , Subtraction - Base method , Subtraction - Completing the whole, Subtraction from left to right

## UNIT-II

Multiplication: Ekadhikenpurven method (multiplication of two numbers of two digits), Eknunenpurven method (multiplication of two numbers of three digits), Urdhvatiragbhyam method (multiplication of two numbers of three digits), Nikhilam Navtashchramam Dashtaha (multiplication of two numbers of three digits), Combined Operations

Division and Divisibility: Division, Nikhilam Navtashchramam Dashtaha (two digits divisor), Paravartya Yojyet method (three digits divisor)

Divisibility: Ekadhikenpurven method (two digits divisor), Eknunenpurven method (two digits divisor)

## UNIT-III

Least Common Multiple (**LCM**) and Highest Common Factor (**HCF**)

Power and Root Power: Square (two digit numbers), Cube (two digit numbers).

Root: Square root (four digit number), Cube root (six digit numbers)

## UNIT-IV

Contribution of Indian Mathematicians (In light of Arithmetic) , Aryabhata , Brahmagupta , Mahaveeracharya , Bharti Krishna Tirtha

### Reference Books:

1. Vedic Mathematics, Motilal Banarsi Das, New Delhi.
2. Vedic Ganita: Vihangama Drishti-1, Siksha Sanskriti Uthana Nyasa, New Delhi.
3. Vedic Ganita Praneta, Siksha Sanskriti Uthana Nyasa, New Delhi.
4. Vedic Mathematics: Past, Present and Future, Siksha Sanskriti Uthana Nyasa, New Delhi.
5. Leelavati, Chokhambha Vidya Bhavan, Varanasi.
6. Bharatiya Mathematicians, Sharda Sanskrit Sansthan, Varanasi.

## ASTRONOMY

**Course Code:** : **AUC 106** **Credits (0-0-0)**

**Course Category** : **Audit**

**Pre-requisite Subject** : NIL

**Contact Hours/Week** : 1/2 Lecture : , Tutorial : , Practical:

**Number of Credits** : 0 Credit

**Course Assessment Methods:** Continuous assessment through tutorials, attendance, home assignments, quizzes, practical, Tutorial class, viva voce and Minor tests and One Major Theory Examination.

## UNIT-I

Historical introduction: Old Indian and western – astronomy – Aryabhata, Tycho Brahe, Copernicus, Galileo – Olbers paradox – solar system – satellites, planets, comets, meteorites, asteroids.

Practical astronomy – telescopes and observations & techniques – constellations, celestial coordinates, ephemeris.

Celestial mechanics – Kepler's laws – and derivations from Newton's laws.

Sun: Structure and various layers, sunspots, flares, faculae, granules, limb darkening, solar wind and climate.

## UNIT-II

Stellar astronomy: H-R diagram, color-magnitude diagram – main sequence – stellar evolution – red giants, white dwarfs, neutron stars, black holes – accretion disc – Schwartzchild radius – stellar masses Saha–Boltzman equation – derivation and interpretation.

Variable stars: Cepheid, RR Lyrae and Mira type variables – Novae and Super novae. Binary and multiple star system – measurement of relative masses and velocities. Interstellar clouds – Nebulae.

### UNIT-III

Transformations Generalized Coordinates, Canonical transformations, Conditions for canonical transformation and problem, Poisson brackets, invariance of PB under canonical transformation, Rotating frames of reference, inertial forces in rotating frames.

### UNIT-IV

Relativity and Application Concept of Special Theory of Relativity, Lorentz Transformation, Length Contraction and time dilation, Relativistic addition of velocities, conservation of mass and momentum, Concept of General Theory of Relativity, Equivalence of mass and energy, Relativistic Doppler shift and aberration of light. Lagrangian and Hamiltonian of relativistic particles, Relativistic degenerate electron gas.

#### Reference Books:

1. “Textbook of Astronomy and Astrophysics with elements of Cosmology”, V. B. Bhatia, Narosa publishing 2001.
2. William Marshall Smart, Robin Michael Green “On Spherical Astronomy“, (Editor) Carroll, Bradley W Cambridge University Press ,1977
3. Bradley W.Carroll and Dale A. Ostlie. “Introduction to modern Astrophysics” Addison-Wesley, 1996.
4. Bradley W.Carroll and Dale A. Ostlie, “An Introduction to Modern Astrophysics” Addison Wesley Publishing Company,1996
5. ‘Stellar Astronomy’ by K. D Abhayankar.
6. ‘Solar Physics’ by K. D Abhayankar.

### ARTS OF INDIA

**Course Code:** : **AUC 107** **Credits (0-0-0)**

**Course Category** : **Audit**

**Pre-requisite Subject** : **NIL**

**Contact Hours/Week** : **1/2 Lecture : , Tutorial : , Practical:**

**Number of Credits** : **0 Credit**

**Course Assessment Methods:** Continuous assessment through tutorials, attendance, home assignments, quizzes, practical, Tutorial class, viva voce and Minor tests and One Major Theory Examination.

#### Course Outcomes:

CO1- Students will be introduced to emergence and development of art traditions upto 6th century C.E. Monuments will be studied in their cultural context.

CO2-Students will able to understand the monuments in their religious, regional and stylistic context. Students will be able to prepare plans of the monuments.

#### Unit 1:

Introduction to traditions of Art and Architecture in India . Introduction to Art and Architecture and prelude to historical art. ii. Art of the pre-Mauryan period. iii. Art and Architecture of Mauryan Period iv. Sources of Inspiration of Mauryan Art and Architecture: Foreign and Indigenous.

#### **Unit 2:**

Emergence and Development of Structural Stupa Architecture . Origin of Stupa Architecture. ii. Stupa Architecture - Pre-Mauryan and Mauryan periods. iii. North India, Central India, Deccan and Gandhara iv. Structural monasteries and Chaityas.

Emergence and Development of Rock-cut Architecture. Origin of Rock-cut Architecture. ii. Eastern India, Western Deccan, Eastern Deccan, Central India.

#### **Unit 3:**

Unit 4: Emergence and Development of Temple Architecture (08 hrs) i. Origin of Temple Architecture-Theoretical aspects. ii. Concept and symbolism of Temple. iii. Archaeological remains of structural temples. iv. Temple Architecture during the Gupta period. v. Temple Architecture during the Vakataka period.

#### **Unit 4:**

Sculptural Art and Paintings - Emergence and Development (10 hrs) i. Sculptural Art and Paintings - Concept and Symbolism. ii. Terracottas, Ivories and Bronzes iii. Paintings iv. Stone sculptures-Gandhara, Mathura, Sarnath and Andhra schools of Art. v. Art during the Gupta-Vakataka period.

#### **Recommended Readings:**

1. Barua, B. 1934-37. Barhut Vol. I-III. Calcutta: Indian Research Institute.
2. Cunningham, Alexander 1966. The Bhilsa Topes. Varanasi: Indological Book Corporation.
3. Cunningham, Alexander 1965. The Stupa of Bharhut. Varanasi: Indological Book Corporation.
4. Dallapiccola, L.S.Z. Lallemant. 1980. The Stupa : Its Religious, Historical, and Architectural Significance. Wiesbaden: Franz Steiner Verlag.
5. Dehejia, Vidya 1972. Early Buddhist Rock Temples A Chronological Study. London: Thames and Hudson

### **INTELLECTUAL PROPERTY RIGHTS**

**Course Code:** : **AUC 108** **Credits (0-0-0)**

**Course Category** : **Audit**

**Pre-requisite Subject** : NIL

**Contact Hours/Week** : 1/2 Lecture : , Tutorial : , Practical:

**Number of Credits** : 0 Credit

**Course Assessment Methods:** Continuous assessment through tutorials, attendance, home assignments, quizzes, practical, Tutorial class, viva voce and Minor tests and One Major Theory Examination.

**Course Outcomes:** After the completion of the course the student will be able to

CO1: Create an understanding on Intellectual Properties and the importance of it.

CO2: Understand Trademarks and Trade secrets. To create awareness of unfair completion and methods of it.

CO3: Create awareness on the protection copyrights and patents. Understand the Ownership rights and transfer.

CO4: Create awareness of Cyber laws, Cyber Crime and get understanding of Privacy of Data.

CO5: To create awareness international aspects of IPR and the Emerging Trends in IPR.

### Course Content

**UNIT – I:** Introduction to Intellectual property: Introduction, types of intellectual property—Patent, Trademarks, Copy rights, IPR and World Trade Organization, other international organizations, agencies and treaties, importance of intellectual property rights. Creating Intellectual Property. Intellectual Property Management. Emerging Issues in IPR. Research and Development in India.

**UNIT – II:** Fundamentals of Patent: Historical Overview of Patent Law; Concept of Patent; Patentable Inventions; Procedure for Obtaining Patent; Rights and Obligations of Patent Holder; Transfer and Infringement of Patent Rights, Geographical Indications, Case Study: Apple versus Samsung Patent Dispute.

**UNIT – III:** Trademarks: Purpose and function of trademarks, acquisition of trademark rights, protectable matter, selecting, and evaluating trademark, trade mark registration processes.

**UNIT – IV:** Copy rights: Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law. Law of patents: Foundation of patent law, patent searching process, ownership rights and transfer.

### Textbooks

- Textbook of Intellectual Property Rights, N.K. Acharya. Asia Law House, ed. 2021.
- Intellectual property right, Deborah. E. Bouchoux, Cengage learning.
- Intellectual Property Rights–Pandey Neeraj, Dharni Khushdeep. PHI.
- Intellectual Property Rights: Text and Cases R. Radhakrishnan, S. Balasubramanian. Excel Books.

### Reference Books

- 1) Intellectual property right – Unleashing the knowledge economy, Prabuddha Ganguli, Tate McGraw Hill ltd.
- 2) A short course in International Intellectual Property Rights – Karla C. Shippey, World Trade Press.
- 3) Intellectual Property Rights – Heritage, Science, & Society under international treaties – A. Subbian, - Deep & Deep Publications – New Delhi.

## HUMAN RIGHTS

**Course Code:** : **AUC 109** **Credits (0-0-0)**

**Course Category** : **Audit**

**Pre-requisite Subject** : **NIL**

**Contact Hours/Week** : **1/2 Lecture : , Tutorial : , Practical:**

**Number of Credits** : **0 Credit**

**Course Assessment Methods:** Continuous assessment through tutorials, attendance, home assignments, quizzes, practical, Tutorial class, viva voce and Minor tests and One Major Theory Examination.

### Course Outcomes:

On completion of the course, students will be able to:

1. Simply put, human rights education is all learning that develops the knowledge, skills, and values of human rights.
2. Strengthen the respect for human rights and fundamental freedoms.
3. Enable all persons to participate effectively in a free society.
4. Learn about human rights principles, such as the universality, indivisibility, and interdependence of human rights.

#### UNIT-I

**The Basic Concepts:** Individual, Group, Civil Society, State, Equality, Justice, Human Values: Humanity, Virtues, Compassion.

#### UNIT-II

**Human**

##### **Rights and Human Duties:**

- i) Philosophical and historical foundation of human rights and duties
- ii) Theories of rights
- iii) Concept and classifications of human rights and duties
- iv) Human rights and duties
  1. Correlation of rights and duties/responsibilities
  2. Tensions between rights inter se, duties inter se, and rights and duties

#### UNIT-III

**Society, Religion, Culture, and their Inter-Relationship:** Impact of Social Structure on Human behavior, Roll of Socialization in Human Values, Science and Technology, Modernization, Globalization, and Dehumanization.

#### UNIT-IV

**Social Structure and Social Problems:** Social and Communal Conflicts and Social Harmony, Rural Poverty, Unemployment, Bonded Labour, Migrant workers and Human Rights Violations, Human Rights of mentally and physically challenged.

#### **Books & References:**

1. Shastry, T. S. N., India and Human rights: Reflections, Concept Publishing Company India (P Ltd), 2005.
2. Nirmal, C.J., Human Rights in India: Historical, Social and Political Perspectives (Law in India), Oxford India.

#### **LOGICAL RESEARCH**

|                              |          |                                                |                        |
|------------------------------|----------|------------------------------------------------|------------------------|
| <b>Course Code:</b>          | <b>:</b> | <b>AUC 110</b>                                 | <b>Credits (0-0-0)</b> |
| <b>Course Category</b>       | <b>:</b> | <b>Audit</b>                                   |                        |
| <b>Pre-requisite Subject</b> | <b>:</b> | <b>NIL</b>                                     |                        |
| <b>Contact Hours/Week</b>    | <b>:</b> | <b>1/2 Lecture : , Tutorial : , Practical:</b> |                        |
| <b>Number of Credits</b>     | <b>:</b> | <b>0 Credit</b>                                |                        |



**Course Assessment Methods:** Continuous assessment through tutorials, attendance, home assignments, quizzes, practical, Tutorial class, viva voce and Minor tests and One Major Theory Examination

**Course outcomes:** In this course you should develop the following competencies:

CO1: To understand about research methodology with its different aspects, about logical reasoning, and types of research.

CO2: It will also result in knowledge appraisal from data collection to data interpretation.

CO3: Mathematical reasoning will also help them to acquire several skills required for the placement.

### Course Content

**UNIT1-** Research Methodology: meaning, characteristics, Types of research; Process of research; Research methods and Ethical issues in research.

**UNIT2-** Logical Reasoning: arguments, deductive and inductive research, quantitative and qualitative research, scientific research; logical approach in research - Venn diagram; Inferences; analogies.

**UNIT3-** Data collection, Organization of data, Data analysis and mapping, Parametric and non-parametric; Data Interpretation.

**UNIT4-** Mathematical Reasoning, number series, letter series, codes; relationships, classification.

### References:

1. Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition
2. Business Research Methods – Alan Bryman & Emma Bell, Oxford University Press.
3. Research Methodology – C.R. Kothari
4. Marketing Research- G C Beri
5. Logical reasoning- R S Agarwal

## PROFESSIONAL ETHICS

**Course Code:** : **AUC 111** **Credits (0-0-0)**

**Course Category** : **Audit**

**Pre-requisite Subject** : NIL

**Contact Hours/Week** : 1/2 Lecture : , Tutorial : , Practical:

**Number of Credits** : 0 Credit

**Course Assessment Methods:** Continuous assessment through tutorials, attendance, home assignments, quizzes, practical, Tutorial class, viva voce and Minor tests and One Major Theory Examination.

### Course Outcomes

Course Outcomes: After the completion of the course the student will be able to-

CO1: Understand the core values that shape the ethical behaviour of a professional.

CO2: Identify the multiple ethical interests at stake in a real-world situation or practice.

CO3: Explain the role and responsibility in technological development by keeping personal ethics and legal ethics.

CO4: Solve moral and ethical problems through exploration and assessment by established experiments.

CO5: Apply the knowledge of human values and social values to contemporary ethical values and global issues.

### Course Content

**Unit I:**

**Understanding Professional Ethics and Human Values:** Morals, values and Ethics – Integrity- Academic integrity-Work Ethics- Service Learning- Civic Virtue Respect for others- Living peacefully- Caring and Sharing- Honestly- courage-Cooperation commitment Empathy-Self Confidence -Social Expectations.

**Unit II:**

Ethics for Engineers: Ethics – its importance – code of ethics – person and virtues – habits and morals – 4 main virtues – ethical theories – Kohlberg’s theory – Gilligan’s theory – towards a comprehensive approach to moral behaviour – truth – approach to knowledge in technology.

**Unit III:**

Environmental Ethics and Sustainability: Problems of environmental ethics in engineering – engineering as profession serving people – engineer’s responsibility to environment – principles of sustainability – industrial, economic, environmental, agricultural, and urban sustainability – Sustainable development. - Global Ethical Issues.

**Unit IV:**

Social Experimentation, Responsibility and Rights: Engineers and responsible experiments – safety and risk – confidentiality – knowledge gained confidentiality – experimental nature of engineering – Intellectual Property Rights – professional rights – employee rights – occupational crime.

**Textbooks**

- Mike W Martin, Roland Schinzinger, “ Ethics in Engineering”, Tata McGraw –Hill.
- Govindarajan M, Natarajan S, Senthil Kumar V S, “Engineering Ethics” PHI India.
- R.R Gaur, R Sangal, G P Bagaria, A foundation course in Human Values and professional Ethics, Excel books, New Delhi.

**Reference Books**

- Aarne Vesblind, Alastair S Gunn, “Engineering Ethics and the Enviornment”.
- Edmund G Seebauer, Robert L Barry, “Fundamentals of Ethics for scientists and engineers” Oxford University Press.
- B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.

**ENVIRONMENTAL LAWS**

**Course Code:** : **AUC 112** **Credits (0-0-0)**

**Course Category** : **Audit**

**Pre-requisite Subject** : **NIL**

**Contact Hours/Week** : **1/2 Lecture : , Tutorial : , Practical:**

**Number of Credits** :

**Course Assessment Methods:** Continuous assessment through tutorials, attendance, home assignments, quizzes, practical, Tutorial class, viva voce and Minor tests and One Major Theory Examination.

**Course Outcomes:**

The course gives students the opportunity to grapple with contemporary legal debates in environment law. Therefore, the learning outcomes of this course can be encapsulated as follows:

- 1) The primary learning outcome is to sensitize the students towards human activities that adversely affect the environment and the need for regulation of such activities.
- 2) Students will develop a thorough understanding of practice and procedure followed by various environmental law enforcing agencies/bodies.
- 3) Students will be able to pursue environmental litigation before the National Green Tribunal and assist the Tribunal as a researcher or in any other capacity.
- 4) Students will be able to assist industries and projects in obtaining environmental clearance and compliances with other environmental laws.

## **UNIT-I**

### **Development of Environmental Laws and Policies in India:**

- I. Concept of 'environment' and understanding scope of environmental law.
- II. Two approaches towards environmental protection- 'Eco-centric approach' and 'Anthropocentric' approach.
- III. Impact of IEL on environmental law in India.
- IV. Significance of Environmental Protection in Five Year Plans.
- V. Development of the 'Right to Environment' as a Fundamental Right and challenges.

## **UNIT-II**

## **Judicial**

### **remedies and the role of National Green Tribunal:**

- I. Civil Remedies i.e. Tortious remedy and Class Action
- II. Criminal Law Remedies under relevant provisions of Indian Penal Code, 1860 and Criminal Procedure Code, 1973
- III. Constitutional Law Remedies i.e. Writ Jurisdiction & Public Interest Litigation
- IV. Statutory Remedies i.e. Remedies under Public Liability Insurance Act 1991, National Environment Tribunal Act, 1995, National Green Tribunal Act, 2010

## **UNIT-III**

### **Statutory framework for Prevention of Environmental, Air and Water Pollution:**

- I. Water (Prevention and Control of Pollution) Act 1974 [Framework of the Act, Criminal Liability and Judicial relief under the Act, Constitutional Challenges of Restraining Orders under Section 33]
- II. The Air (Prevention and Control of Pollution) Act 1981 [Framework of the Act, Criminal Liability and Judicial relief under the Act, Noise Pollution]
- III. Environment (Protection) Act, 1986 [Framework of the Act, Enforcement mechanisms and Role of Pollution Control Boards, Environment Impact Assessment, Coastal zone regulations Notifications]
- IV. Law on Waste Management and Handling
- V. Procedural environmental rights under various environmental laws
  - Right to Information
  - Right to public consultation
  - Right of access to justice

## **UNIT-IV**

### **Statutory framework governing Forest, Wildlife and Biodiversity:**

- II. Statutory Framework on Forest Preservation [The Indian Forest Act, 1927; Forest (Conservation) Act, 1980; National Forest Policy, 1988; The Scheduled Tribe and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006]

- III. Statutory Framework on Wildlife & Biodiversity Protection [The Wildlife (Protection) Act, 1972; Implementation and gaps and Judicial Perspective; Biological Diversity Act, 2002]

### **Books & References:**

- 1) Shyam Divan & Armin Rosencranz, Environmental Law & Policy in India (2<sup>nd</sup> ed, Oxford University Press, 2014)
- 2) P. Leelakrishnan, Environmental law in India (4<sup>th</sup> ed, LexisNexis, 2016)
- 3) Lavanya Rajamani and Shibani Ghosh, Indian Environmental Law: Key Concepts and Principles (Orient Blackswan, 2019)
- 4) Gitanjali Nain Gill, Environmental Justice in India: The National Green Tribunal (Routledge, 2017)
- 5) Patricia Birnie, Alan Boyle and Catherine Redgwell, International Law and the Environment (3<sup>rd</sup> ed., Oxford University Press, 2009)
- 6) Philippe Sands, Principles of International Environmental Law (2<sup>nd</sup> ed, Cambridge University Press, 2003)

## **HEALTH LAW**

**Course Code:** : **AUC 113** **Credits (0-0-0)**

**Course Category** : **Audit**

**Pre-requisite Subject** : NIL

**Contact Hours/Week** : ½ Lecture : , Tutorial : , Practical:

**Number of Credits** : 0 Credit

**Course Assessment Methods:** Continuous assessment through tutorials, attendance, home assignments, quizzes, practical, Tutorial class, viva voce and Minor tests and One Major Theory Examination

**Course Outcomes:** In this course you should develop the following competencies:

CO1: Knowledge and understanding of the values and policies underlying Health Law.

CO2: Knowledge and understanding of substantive law related to health care, health care insurance markets as well as related procedural law.

CO3: Written and oral communication in the legal context.

### **Course Content**

**UNIT-1 BASICS OF HEALTH LAW-** Basic of Health and its provider, Origin & Evaluation, All Council Acts.

**UNIT-2 NEED FOR HEALTH LAW** -Fraudulence, Negligence and Abuse, Human Rights, Rights & Duties of Health Care Provider (Public & Private Activities).

**UNIT-3 LEGAL ASPECTS OF HEALTH LAW-** Role of Health Policy & Health Care Delivery, General Laws on Health Law (Medical Allied Agencies), Specific Laws on Health Law (NDT, PWD/etc.).

**UNIT-4 MEDICAL INSURANCE** –Introduction-Various types, Significance and Kind of Medical Insurance/Policies, Insurance & Assurance, General Principles of Law and Contract, Medical Insurance Regulations.

## REFERENCES:

- 1)Jonathan Herring- Medical Law and Ethics
- 2)Mason and Mc Call Smith- Law and Medical Ethics
- 3)S. V. Jogarao- Current Issues in Criminal Justice and Medical Law

### National Cadet Corps (NCC)

|                              |          |                                       |                        |
|------------------------------|----------|---------------------------------------|------------------------|
| <b>Course Code:</b>          | <b>:</b> | <b>AUC 114</b>                        | <b>Credits (0-0-0)</b> |
| <b>Course Category</b>       | <b>:</b> | <b>Audit</b>                          |                        |
| <b>Pre-requisite Subject</b> | <b>:</b> | NIL                                   |                        |
| <b>Contact Hours/Week</b>    | <b>:</b> | ½ Lecture : , Tutorial : , Practical: |                        |
| <b>Number of Credits</b>     | <b>:</b> | 0 Credit                              |                        |

**Course Outcomes:** In this course you should develop the following competencies:

CO1: Imbibe the conduct of NCC cadets.

CO2: Respect the diversity of different Indian culture.

CO3: Perform his/her role in Nation Building

CO4: Do the social services on different occasions.

CO5: Practice togetherness and empathy in all walks of their life.

CO6: Do the asana and gain the physical& mental fitness

### Course Content

#### UNIT 1

##### NCC General

History, Aims, Objective of NCC, NCC as Organization. Incentives of NCC, Duties of NCC Cadet, NCC Camps: Types & Conduct.

#### UNIT 2

##### National Integration & Awareness

National Integration: Importance & Necessity, Factors Affecting National Integration, Unity in Diversity & Role of NCC in Nation Building, Threats to National Security

#### UNIT 3

##### Social Service and Community Development

Celebration of Days of National & International Importance, Social Service and Community Development Activities to be conducted.

#### UNIT 4

##### Health & Hygiene:

Yoga- Introduction, Definition, Purpose, Benefits.

Asanas-Padamsana, Siddhasana, Gyan Mudra, Surya Namaskar, Shavasana, Vajrasana, Dhanurasana, Chakrasana, Sarvaangasana, Halasana etc.

##### Textbooks:

1. R. Gupta, "NCC: Handbook of NCC Cadets for 'A', 'B' and 'C' Certificate Examinations" 1<sup>st</sup> Edition (English, Paperback, RPH Editorial Board)

### Basics of Human Health and Preventive Medicines

|                              |          |                                        |                        |
|------------------------------|----------|----------------------------------------|------------------------|
| <b>Course Code:</b>          | <b>:</b> | <b>AUC 115</b>                         | <b>Credits (0-0-0)</b> |
| <b>Course Category</b>       | <b>:</b> | <b>Audit</b>                           |                        |
| <b>Pre-requisite Subject</b> | <b>:</b> | NIL                                    |                        |
| <b>Contact Hours/Week</b>    | <b>:</b> | 1/2 Lecture: , Tutorial : , Practical: |                        |
| <b>Number of Credits</b>     | <b>:</b> | 0 Credit                               |                        |

**Course Assessment Methods:** Continuous assessment through tutorials, attendance, home assignments, quizzes, practical, Tutorial class, viva voce and Minor tests and One Major Theory Examination.

#### UNIT- 1

**Health-** Definition, dimensions, concept of wellbeing, Physical quality of life index, Spectrum of health, Determinants of health.

**Concept of disease-** Epidemiological triad, Natural history of disease, Risk factors, risk group, Iceberg of disease, Disease control, Disease elimination, Disease eradication, **Monitoring and surveillance-** Concept of prevention, Primary, Secondary and Tertiary, Modes of Intervention.

#### UNIT- 2

**Communicable diseases-** Type of microorganisms, Mode of transmission, Prevention of infectious diseases, Vaccination/immunization.

**Diarrheal diseases and dehydration-** Prevention and role of ORS.

**Fever-** cause and how to deal with.

**Respiratory problems and cough**

#### UNIT - 3

**Non communicable diseases/ Lifestyle related disorder-** Risk factors, CAD, risk and prevention, Hypertension, Diabetes mellitus, Obesity, Cancer, Accidents.

#### UNIT – 4

**Nutrition and health-** Classification of food, Balance diet.

**Occupational hazards**

**Mental health and substance abuse**

**Medical Emergencies-** BLS and ALS.

#### Reference Textbook

- 1) K. Park – “Park’s Textbook of Preventive and Social Medicine”
- 2) Yash Pal Bedi & Pragya Sharma– “Handbook of Preventive and Social Medicine, Seventeenth Edition, CBS Publication”.
- 3) Sunder Lal, Adarsh, Pankaj – “Update on Textbook of Community Medicine Preventive and Social Medicine with Recent Advances” 5<sup>th</sup> Edition, Publication 2018.
- 4) Dr. B. Saha- “Preventive and Social Medicine Communicable Disease Hygiene”.
- 5) Rabindra Nath Roy, Indernil Saha- “Mahajan and Gupta Textbook of Preventive and Social Medicine” 4<sup>th</sup> Edition, Japee

### CONSTITUTION OF INDIA AND ENVIRONMENTAL GOVERNANCE: ADMINISTRATION AND ADJUDICATION

|                                 |                                                                                                                                                        |                        |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| <b>Course Code</b>              | <b>: AUC 116</b>                                                                                                                                       | <b>Credits (0-0-0)</b> |
| <b>Course Category</b>          | <b>: VAC (Audit)</b>                                                                                                                                   |                        |
| <b>Pre-Requisite Subject</b>    | <b>: NIL</b>                                                                                                                                           |                        |
| <b>Contact Hours/ Week</b>      | <b>: 1 / 2 Lecture, Tutorial, Practical</b>                                                                                                            |                        |
| <b>Number of Credits</b>        | <b>: 0 Credit</b>                                                                                                                                      |                        |
| <b>Course Assessment Method</b> | <b>: Continuous assessment through Tutorial classes, Home Assignments, Quizzes, Practical, Viva-Attendance, Minor Tests and One Major Examination.</b> |                        |
| <b>Voce, Theory</b>             |                                                                                                                                                        |                        |

#### COURSE OUTCOME

At the end of the course, learners should be able to:

CO1- Understand the fundamental principles of environmental governance.

CO2- Understand Constitutional perspectives of environmental governance in India.

CO3- Procedural compliance under environmental legislations and role of Judiciary and quasi-judicial bodies in environmental governance.

CO4- Develop an understanding of bio-diversity conservation, climate change, forest protection, waste management and other issues.

## **COURSE CONTENTS**

### **UNIT-I: Foundations of Environmental Law and Governance**

Principles and Legal Instruments of Environmental Governance  
Emerging Trends in Environmental Law

### **UNIT- II: Constitution of India and the articles relating Environment**

Pollution Control Laws and Administrative processes  
Environment Protection Act and Administrative processes  
Waste Management Laws and Role of Municipalities and other agencies

### **UNIT- III: Basics of Forest Management in India**

Judiciary and its role  
Biodiversity Laws and its Application; ABS Guidelines

### **UNIT- IV: Wildlife Protection and management in India**

Adjudicatory Mechanisms- Supreme Court, High Court, National Green Tribunal

## **BOOKS AND REFERENCES**

- Philippe Sands, Principles of International Environmental Law, Cambridge, 2018
- Indian Environmental Law: Key Concepts and Principles, ed. Shibani Ghosh, Orient BlackSwan (2019).
- Nawneet Vibhaw, Environmental Law: An Introduction, LexisNexis (2016).
- Shyam Divan and Armin Rosencranz, Environmental Law and Policy in India: Cases, Material & Statutes
- Justice T S Doabia (2010) Environmental and Pollution Laws in India, Lexis Nexis Butterworths Wadhwa. Chapters 10 and 11.
- S Ghosh, S Lele, N Henle, Appellate Authorities under Pollution Control Laws in India: Powers, Problems and Potential, LEAD 2018
- Ritwick Dutta and Bhupender Yadav (2012) Supreme Court on Forest Conservation, Universal Law Publishing. Introduction (The Court's Journey through Forests) and Chapter 1.
- Gitanjali Gill, Environmental Justice in India: The National Green Tribunal, Routledge (2016)
- Abhayraj Naik and Parul Kumar, India's Domestic Climate Policy is Fragmented and Lacks Clarity, available at <https://www.epw.in/engage/article/indias-domestic-climate-policy-fragmented-lacks-clarity>
- Suggested Documentaries- Climate Change the Facts, BBC (April, 2019)

## **DIRECTIVE PRINCIPLES OF STATE POLICY AND FUNDAMENTAL DUTIES: CONSTITUTIONAL IMPERATIVE**

|                                 |                                                                                                          |                        |
|---------------------------------|----------------------------------------------------------------------------------------------------------|------------------------|
| <b>Course Code</b>              | <b>: AUC 117</b>                                                                                         | <b>Credits (0-0-0)</b> |
| <b>Course Category</b>          | <b>: VAC (Audit)</b>                                                                                     |                        |
| <b>Pre-Requisite Subject</b>    | <b>: NIL</b>                                                                                             |                        |
| <b>Contact Hours/ Week</b>      | <b>: 1 / 2 Lecture, Tutorial, Practical</b>                                                              |                        |
| <b>Number of Credits</b>        | <b>: 0 Credit</b>                                                                                        |                        |
| <b>Course Assessment Method</b> | <b>: Continuous assessment through Tutorial classes,<br/>Home Assignments, Quizzes, Practical, Viva-</b> |                        |

**Voce,  
Major Theory**

**Attendance, Minor Tests and One  
Examination.**

### **COURSE OUTCOME**

At the end of the course, learners should be able to:

- CO1- Understand the fundamental concepts behind Directive Principles of State Policy.
- CO2- Evolution and the adoption of the DPSP through the Constituent Assembly debates.
- CO3- Learn how the three organs of the governance play role in shaping and achieving DPSP.
- CO4- Understand the basics and relevance of Fundamental Duties.
- CO5- Evaluate the relationship between Indian Knowledge System and Fundamental Duties.

### **COURSE LAYOUT**

**UNIT-I:** Evolution and Concept of Directive Principles of State Policy, Incorporation of the Directive Principles of State Policy: Constituent Assembly Debates

**UNIT-II:** Salient Features of the Directive Principles of State Policy under the Indian Constitution, The Legislative, the Executive and the Judiciary on the Directive Principles of the State Policy

**UNIT III:** The Legislative, the Executive and the Judiciary on the Directive Principles of the State Policy (Cont.), Evolution and Relevance of the Fundamental Duties

**UNIT-IV:** Relationship between Fundamental Duties and Indian Knowledge System, The Legislative, the Executive and the Judiciary on Fundamental Duties

### **BOOKS AND REFERENCES**

- H.M. Seervai, Constitutional Law of India, Vol. I and 2, Universal Law Publishing (LexisNexis) 4th Edition, 2015
- Samaraditya Pal, India's Constitution: Origins and Evolution, Vol. 3, LexisNexis, 2015  
Constituent Assembly Debates, Lok Sabha Secretariat
- Justice R C Lahoti, Fundamental Duties: A Forgotten Chapter of the Constitution, LexisNexis, 2015
- NCRWC, A Consultation Paper on Effectuation of Fundamental Duties of Citizens, 2001
- Granville Austin, The Indian Constitution: A Cornerstone of a Nation, Oxford Clarendon Press, 1966.

### **INTRODUCTION TO INTELLECTUAL PROPERTY TO ENGINEERS AND TECHNOLOGISTS**

|                                 |                                                                                                                                                                     |                        |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| <b>Course Code</b>              | <b>: AUC 118</b>                                                                                                                                                    | <b>Credits (0-0-0)</b> |
| <b>Course Category</b>          | <b>: VAC (Audit)</b>                                                                                                                                                |                        |
| <b>Pre-Requisite Subject</b>    | <b>: NIL</b>                                                                                                                                                        |                        |
| <b>Contact Hours/ Week</b>      | <b>: 1 / 2 Lecture, Tutorial, Practical</b>                                                                                                                         |                        |
| <b>Number of Credits</b>        | <b>: 0 Credit</b>                                                                                                                                                   |                        |
| <b>Course Assessment Method</b> | <b>: Continuous assessment through Tutorial classes,<br/>Home Assignments, Quizzes, Practical, Viva-<br/>Attendance, Minor Tests and One Major<br/>Examination.</b> |                        |
| <b>Voce,<br/>Theory</b>         |                                                                                                                                                                     |                        |

### **COURSE OUTCOME**

After the completion of the course the learners should be able to:

- CO1: Create an understanding on Intellectual Properties and the importance of it.
- CO2: Learn basics of Patents, Trademarks and copyrights.



CO3: Create awareness on the filing, protection copyrights and patents and understand the Ownership rights and their transfer.

CO4: Understand trade secrets and able to compare their positives and negatives traits.

CO5:, Aware of emerging trends in IPR, and learn about IP management.

### **COURSE LAYOUT**

**UNIT -I:** Introduction to Intellectual Property, Types of intellectual property—Patent, Trademarks, Copy rights, IPR and World Trade Organization, Other international organizations,

**UNIT -II:** Basics of Patent, Patent filing procedure, Obligations of Patent Holder, Basics of Copyright- Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration Industrial Design, Emerging issue

**UNIT -III:** Trademark basic, Purpose and function of trademarks, acquisition of trademark rights, protectable matter, selecting, and evaluating trademark, trade mark registration processes GI basic, IC Layout Design

**UNIT –IV:** Trade secret, Comparative analysis, IP management

### **BOOKS AND REFERENCES:**

- THE ECONOMIC STRUCTURE OF INTELLECTUAL PROPERTY LAW, William M. LANDES, Richard A. Posner, Harvard University Press, 2003.
- Intellectual Property and Development: Theory and Practice, Rami M. Olwan, Springer
- Narayanan, P (2006) Intellectual Property Law. 3rd edition. Eastern Law House
- Colston, C., Middleton, K. 2004 Modern Intellectual Property Law. 2nd Edition. Cavendish Publishing Ltd
- Cornish W, Llewelyn, D (2003) Intellectual Property: Patents, Copyrights, Trademarks and Allied rights. Fifth edition. Sweet and Maxwell.
- William M. Landes & Richard A. Posner, Indefinitely Renewable Copyright, 70 U. CHI. L. REV. Goldstein, Kitch and Perlman, 2006, Selected Statutes and International Agreements on Unfair Competition, Trademark, Copyright, and Patent
- Paul Goldstein, 2002, Copyright, Patent, Trademark and Related State Doctrines: Cases and Materials on Intellectual Property Law, Revised 5th edition, New York, NY: Foundation Press, 1025 pages.
- T.K.Bandyopadhyay and Saurabh Bindal, “Introduction to Intellectual Property” 1st edition Eastern Book Company, 2015

|                                  |          |                                                                                                                                                         |
|----------------------------------|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>AUC119</b>                    | <b>:</b> | <b>Fundamentals of Artificial Intelligence</b>                                                                                                          |
| <b>Course category</b>           | <b>:</b> | Audit Course                                                                                                                                            |
| <b>Pre-requisite</b>             | <b>:</b> | Basic Programming Knowledge                                                                                                                             |
| <b>Subject</b>                   |          |                                                                                                                                                         |
| <b>Contact</b>                   | <b>:</b> | Lecture: 2, Tutorial: 0, Practical:0                                                                                                                    |
| <b>hours/week</b>                |          |                                                                                                                                                         |
| <b>Number of Credits</b>         | <b>:</b> | 0                                                                                                                                                       |
| <b>Course Assessment methods</b> | <b>:</b> | Continuous assessment through assignments, quizzes, tutorials, course-based project, one minor test and one major examination                           |
| <b>Course Objectives</b>         | <b>:</b> | The course aims to:<br>1. Introduce fundamental concepts of Artificial Intelligence.<br>2. Develop basic Python programming skills for AI applications. |

3. Build foundations in data analysis and preprocessing.
4. Provide understanding of machine learning concepts.
5. Expose students to AI use cases in various engineering domains.

**Course Outcomes** : After successful completion of this course, students will be able to:

CO1. Understand fundamental concepts of Artificial Intelligence and intelligent systems.

CO2. Apply Python libraries for data handling and visualization.

CO3. Perform data preprocessing and exploratory data analysis.

CO4. Understand basic machine learning concepts and evaluation metrics.

CO5. Identify and analyze AI applications in various engineering domains.

CO6. Develop simple AI-based solutions using data preprocessing, visualization, and basic machine learning models.

## Topics Covered

### UNIT I: Introduction to AI and Python Programming 6

Overview of Artificial Intelligence: History, scope, types of AI, Applications of AI in modern technology, Python Basics: Data types, variables, operators, Control Structures: Conditional statements, loops, Functions and Modules, Data Structures: Lists, tuples, dictionaries, sets, File Handling Introduction to NumPy, Pandas, Matplotlib.

### UNIT II: Exploratory Data Analysis 6

Types of Data: Numerical and Categorical, Steps in Exploratory Data Analysis, Descriptive Statistics, Data Visualization Techniques, Introduction to Data-driven Decision Making.

### UNIT III: Data Preprocessing and Introduction to Machine Learning 6

Data Cleaning and Deduplication, Handling Missing Data, Data Transformation: Normalization, Scaling, Binning, Introduction to Supervised and Unsupervised Learning (Conceptual Only), Model Evaluation Metrics: Accuracy, Precision, Recall, F1-score.

### UNIT IV: AI Use Cases in Engineering 6

Predictive maintenance and fault detection in industrial systems using sensor data, Smart infrastructure monitoring, Process optimization, quality inspection, and automation in manufacturing environments, Intelligent decision support systems for healthcare, environmental monitoring, and cybersecurity applications.

## TEXTBOOKS

1. **Aurélien Géron**, *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow*, O'Reilly
2. **Wes McKinney**, *Python for Data Analysis*, O'Reilly
3. **Ethem Alpaydin**, *Introduction to Machine Learning*, MIT Press
4. **Jake VanderPlas**, *Python Data Science Handbook*, O'Reilly

## REFERENCE BOOKS

1. **Ian Goodfellow, Yoshua Bengio, Aaron Courville**, *Deep Learning*, MIT Press
2. **Sebastian Raschka**, *Machine Learning with Python*, Packt
3. **Stuart Russell & Peter Norvig**, *Artificial Intelligence: A Modern Approach*, Pearson

4. **Andreas C. Müller & Sarah Guido**, *Introduction to Machine Learning with Python*, O'Reilly.

### INDIAN KNOWLEDGE THROUGH CLASSICAL LANGUAGES

|                                 |                                                                                                                                                        |                        |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| <b>Course Code</b>              | <b>: IKS 101</b>                                                                                                                                       | <b>Credits (0-0-0)</b> |
| <b>Course Category</b>          | <b>: VAC (Audit)</b>                                                                                                                                   |                        |
| <b>Pre-Requisite Subject</b>    | <b>: NIL</b>                                                                                                                                           |                        |
| <b>Contact Hours/ Week</b>      | <b>: 1 / 2 Lecture, Tutorial, Practical</b>                                                                                                            |                        |
| <b>Number of Credits</b>        | <b>: 0 Credit</b>                                                                                                                                      |                        |
| <b>Course Assessment Method</b> | <b>: Continuous assessment through Tutorial classes, Home Assignments, Quizzes, Practical, Viva-Attendance, Minor Tests and One Major Examination.</b> |                        |
| <b>Voce, Theory</b>             |                                                                                                                                                        |                        |

#### **COURSE OUTCOME:**

At the end of the course learners shall be able to:

CO1- Students will be able to read, understand, and interpret the core texts of Sanskrit, Pali, Prakrit, and other Indian languages.

CO2- Students will analyze the historical and cultural significance of Indian philosophy, science, art, and social practices.

CO3- Students will develop the ability to apply the principles of Indian scriptures and folk traditions to modern contexts.

CO4- Students will critically evaluate the contributions of the Indian Knowledge Tradition in fields like medicine, architecture, and science.

CO5- Students will be equipped to promote and preserve the Indian Knowledge Tradition through innovative and creative approaches.

#### **COURSE CONTENTS**

##### **Unit I: Sanskrit Language-Based Indian Knowledge Tradition**

##### **Objective:**

To understand the fundamental principles, philosophies, and their significance in the Indian Knowledge Tradition through the Sanskrit language and its literature.

##### **Course Content:**

##### **1. Linguistics and Literature:**

- Introduction to Sanskrit language, its grammar (morphology, phonetics), and vocabulary (words, meanings, synonyms, and prosody).

- Key texts: Vedas (Rigveda, Yajurveda, Samaveda, Atharvaveda), Upanishads, Mahabharata, Ramayana, Puranas, and their significance.

##### **2. Philosophy and Religion:**

- Indian philosophical systems (Yoga, Vedanta, Nyaya, Vaisheshika, Mimamsa, Sankhya).

- Core concepts of the Bhagavad Gita and Brahmasutra.

- Jain and Buddhist philosophies (methods, principles, and statements).

##### **3. Science and Mathematics:**

- Mathematics: Contributions of Aryabhata, Bhaskaracharya, and Shulba Sutras.

- Architecture: Sushruta Samhita, Charaka Samhita.

- Ayurveda and Rasashastra (Chemistry): Contributions to medical and chemical sciences.

##### **4. History, Culture, and Society:**

- Elements of history and culture in Sanskrit literature.

- Kautilya's Arthashastra (practical approach).
- Contributions of Kalidasa, Bhavabhuti, and Kabir.
- Musicology: Gandharvacharya, Sangita Ratnakara.

## **Unit II: Pali Language-Based Indian Knowledge Tradition**

### **Objective:**

To understand the Buddhist perspective of the Indian Knowledge Tradition through the Pali language and its literature.

### **Course Content:**

1. Linguistics and Literature:
  - Introduction to Pali language, its structure, grammar, and vocabulary.
  - Primary, secondary (various sutras, commentaries), and tertiary Pali literature.
2. Philosophy and Religion:
  - Buddhist philosophy: Truth and reality, the Eightfold Path, Nirvana.
  - Buddhist meditation practices and their psychological aspects.
3. Architecture and Art:
  - Buddhist architecture: Stupas (Sanchi, Amaravati), viharas, universities (Nalanda, Takshashila, etc.).
  - Buddhist art: Gandhara and Mathura styles, Buddhist iconography.

## **Unit III: Prakrit Language-Based Indian Knowledge Tradition**

### **Objective:**

To understand the Jain perspective of the Indian Knowledge Tradition through the Prakrit language and Jain literature.

### **Course Content:**

1. Linguistics and Literature:
  - Introduction to Prakrit language, its dialects (Shauraseni, Magadhi, Ardhamagadhi).
  - Jain Agamas: Acharanga Sutra, Suttrakritanga, and other texts.
2. Philosophy and Religion:
  - Jain philosophy: Anekantavada (non-absolutism), Syadvada (relativity), and principles of religion.
  - Jain ethics and principles of non-violence.
3. Science and Mathematics:
  - Jain mathematics and cosmology.
  - Contributions of Jainism to astronomy and religion.
4. Culture and Art:
  - Jain architecture: Dilwara temples, Ranakpur.
  - Jain painting and sculpture.
  - Jain music and literary traditions.

## **Unit IV: Indian Knowledge Tradition Based on Other Indian Languages and Folk Traditions**

### **Objective:**

To understand the Indian Knowledge Tradition through Tamil, Telugu, Kannada, and other Indian languages, as well as folk traditions.

### **Course Content:**

1. Linguistics and Literature:
  - Tamil and Telugu literature: Bhakti literature, Tirukkural, and Shaiva-Vaishnava poetry.
  - Folk literature: Kabir, Gita, and oral traditions.
2. Folk Culture and Traditions:
  - Folk arts: Madhubani, Warli.

- Folk music and dance: Bihu, Garba, Lavani.
  - Folk festivals, rituals, and oral traditions.
3. Education and Technology:
- Tamil Siddha medicine and traditional knowledge systems.
  - Traditional water management and folk practices.
  - Folk astronomy and meteorology.
4. Social and Economic Traditions:
- Traditional occupations and practices.
  - Folk beliefs and community life.
  - Regional festivals and their cultural significance.

#### **Resources:**

- Primary texts: Vedas, Upanishads, Puranas, Jain Agamas, Buddhist texts.
- Modern reference books: Works on Indian culture, history, and traditions.
- Digital resources: Digital libraries and online resources for Indian languages.
- Regional manuscripts and traditional knowledge systems.

### **INDIAN KNOWLEDGE SYSTEM: CONCEPTS AND APPLICATIONS IN SCIENCE**

|                                 |                                                                                                                                                        |                        |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| <b>Course Code</b>              | <b>: IKS 102</b>                                                                                                                                       | <b>Credits (0-0-0)</b> |
| <b>Course Category</b>          | <b>: VAC (Audit)</b>                                                                                                                                   |                        |
| <b>Pre-Requisite Subject</b>    | <b>: NIL</b>                                                                                                                                           |                        |
| <b>Contact Hours/ Week</b>      | <b>: 1 / 2 Lecture, Tutorial, Practical</b>                                                                                                            |                        |
| <b>Number of Credits</b>        | <b>: 0 Credit</b>                                                                                                                                      |                        |
| <b>Course Assessment Method</b> | <b>: Continuous assessment through Tutorial classes, Home Assignments, Quizzes, Practical, Viva-Attendance, Minor Tests and One Major Examination.</b> |                        |
| <b>Voce, Theory</b>             |                                                                                                                                                        |                        |

#### **COURSE OUTCOME**

At the end of the course, learners should be able to:

- CO1- Understand the basic concepts of Science in Indian Knowledge Systems.
- CO2- Get an overview of aspects in which ancient science played impactful role.
- CO3- Develop an insight for utilizing the scientific knowledge into contemporary fields.

#### **COURSE CONTENTS**

##### **UNIT -I:** Indian Knowledge System – An Introduction

The Vedic Corpus- Vedas, Upanishads, Schools of philosophy  
 Buddhist Corpus- Tripitakas, Jataka Tales  
 Jaina Corpus- Agamas  
 Wisdom through the Ages

##### **UNIT- II:** Number Systems and Units of Measurement

Mathematics- Overview, Vaidic and Later age mathematics  
 Astronomy- Overview and contributions

##### **UNIT-III:** Knowledge Framework and classifications

Linguistics- Panini & Sanskrit, Pali and Prakrit

##### **UNIT IV:** Health Wellness and Psychology

Town Planning and Architecture

#### **BOOKS AND REFERENCES:**

**Mahadevan, B., Bhat Vinayak Rajat, Nagendra Pavana R.N. (2022),** “Introduction to Indian Knowledge System: Concepts and Applications”, PHI Learning Private Ltd. Delhi.

### ADDITIONAL READINGS:

- Pride of India: A Glimpse into India's Scientific Heritage, Samskrita Bharati, New Delhi.
- Sampad and Vijay (2011). "The Wonder that is Sanskrit", Sri Aurobindo Society, Puducherry.
- Acarya, P.K. (1996). Indian Architecture, MunshiramManoharlal Publishers, New Delhi.
- Banerjea, P. (1916). Public Administration in Ancient India, Macmillan, London.
- Kapoor Kapil, Singh Avadhesh (2021). "Indian Knowledge Systems Vol – I & II", Indian Institute .of Advanced Study, Shimla, H.P
- Verma. Keshav Dev. (2012) Vedic Physics, Motilal Banarsidass Publishers.

### INDIAN KNOWLEDGE SYSTEM: CONCEPTS AND APPLICATIONS IN ENGINEERING

|                                 |                                                                                                                                                        |                        |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| <b>Course Code</b>              | <b>: IKS 103</b>                                                                                                                                       | <b>Credits (0-0-0)</b> |
| <b>Course Category</b>          | <b>: VAC (Audit)</b>                                                                                                                                   |                        |
| <b>Pre-Requisite Subject</b>    | <b>: NIL</b>                                                                                                                                           |                        |
| <b>Contact Hours/ Week</b>      | <b>: 1 / 2 Lecture, Tutorial, Practical</b>                                                                                                            |                        |
| <b>Number of Credits</b>        | <b>: 0 Credit</b>                                                                                                                                      |                        |
| <b>Course Assessment Method</b> | <b>: Continuous assessment through Tutorial classes, Home Assignments, Quizzes, Practical, Viva-Attendance, Minor Tests and One Major Examination.</b> |                        |
| <b>Voce, Theory</b>             |                                                                                                                                                        |                        |

### COURSE OUTCOME

At the end of the course, learners should be able to:

- CO1- Understand the basic concepts of Engineering in Indian Knowledge Systems.
- CO2- Get an overview of aspects in which ancient Engineering played an impactful role.
- CO3- Develop an insight for utilizing the scientific knowledge into contemporary fields.
- CO4- Understand the role of Engineering in town planning in ancient India.
- CO5- Understand the interrelation of Astronomy and Architecture.

### COURSE LAYOUT

**UNIT-I:** Indian Knowledge System – An Introduction

The Vedic Corpus

**UNIT-II:** Number System and Units of Measurements

Mathematics

Astronomy

**UNIT-III:** Engineering and Technology: Metals and Metalworking

Engineering and Technology: Other Applications

**UNIT-IV:** Town Planning and Architecture

Knowledge Framework and Classification

Linguistics

### BOOKS AND REFERENCES:

**Mahadevan, B., Bhat Vinayak Rajat, Nagendra Pavana R.N. (2022), "Introduction to Indian Knowledge System: Concepts and Applications", PHI Learning Private Ltd. Delhi.**

### ADDITIONAL READINGS:

- Pride of India: A Glimpse into India's Scientific Heritage, Samskrita Bharati, New Delhi.
- Sampad and Vijay (2011). "The Wonder that is Sanskrit", Sri Aurobindo Society, Puducherry.
- Bag, A.K. (1979). Mathematics in Ancient and Medieval India, Chaukhamba Orientalia, New Delhi.
- Datta, B. and Singh, A.N. (1962). History of Hindu Mathematics: Parts I and II, Asia Publishing House, Mumbai.

- Kak, S.C. (1987). "On Astronomy in Ancient India", Indian Journal of History of Science, 22(3), pp. 205–221.
- Subbarayappa, B.V. and Sarma, K.V. (1985). Indian Astronomy: A Source Book, Nehru Centre, Mumbai.
- Bag, A.K. (1997). History of Technology in India, Vol. I, Indian National Science Academy, New Delhi.
- Acarya, P.K. (1996). Indian Architecture, Munshiram Manoharlal Publishers, New Delhi.
- Banerjea, P. (1916). Public Administration in Ancient India, Macmillan, London.
- Kapoor Kapil, Singh Avadhesh (2021). "Indian Knowledge Systems Vol – I & II", Indian Institute of Advanced Study, Shimla, H.P.

### **INDIAN KNOWLEDGE SYSTEM**

|                                 |                                                                                                                                                        |                        |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| <b>Course Code</b>              | <b>: IKS 104</b>                                                                                                                                       | <b>Credits (0-0-0)</b> |
| <b>Course Category</b>          | <b>: VAC (Audit)</b>                                                                                                                                   |                        |
| <b>Pre-Requisite Subject</b>    | <b>: NIL</b>                                                                                                                                           |                        |
| <b>Contact Hours/ Week</b>      | <b>: 1 / 2 Lecture, Tutorial, Practical</b>                                                                                                            |                        |
| <b>Number of Credits</b>        | <b>: 0 Credit</b>                                                                                                                                      |                        |
| <b>Course Assessment Method</b> | <b>: Continuous assessment through Tutorial classes, Home Assignments, Quizzes, Practical, Viva-Attendance, Minor Tests and One Major Examination.</b> |                        |
| <b>Voce, Theory</b>             |                                                                                                                                                        |                        |

### **COURSE OUTCOME**

At the end of the course, learners should be able to:

- CO1- Understand the history, nature and basic philosophy of Indian Knowledge System.
- CO2- Develop basic understanding of ancient epistemological approaches.
- CO3- Get an overview of literary and scriptural corpus of ancient India and its education system.
- CO4- Develop an insight in scientific approaches relevant in contemporary times.
- CO5- Understand ancient India's Governance and Public Administration.

### **COURSE LAYOUT**

#### **Unit 1- History of Indian Knowledge System**

Genesis of Bhartiya Knowledge System  
History of IKS  
IKS: Nature, Philosophy and Character  
India's Epistemology  
Knowledge Frameworks & Classification

#### **Unit 2- Literary Aspects of IKS**

Ancient Scriptures  
Ancient Education  
Educating Sciences  
Chandashastra (Prosody)  
Bhasa Va Vyakarana (Language and Grammar)  
Bharata's Natyashastra (Science of Drama, Dance and Music)  
Khagol Vijnana (Astronomy)  
Vastukala (Architecture)  
Ayurveda  
Krishi Vijnana (Agricultural) Practices

#### **Unit 3- Scientific approaches of IKS & Torch-bearers**

Dhatu Vijnana (Metallurgy)

Ganita: Mathematics in India  
Yuddha Vidhya (Military Sciences)  
Niyuddha Kala (Martial Arts)  
Environmental Sciences

**Unit 4- Governance in IKS & Way Forward**

Science of Consciousness in Ancient India (Cognitive Science)  
Anviksiki (Logic and Disputation)  
Governance & Public Administration  
IKS way forward

**BOOKS AND REFERENCES:**

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- Glimpse into Kautilya’s Arthashastra Ramachandrudu P. (2010), Sanskrit Academy, Hyderabad ISBN:9788380171074
- “Introduction” in Studies in Epics and Purāṇas, (Eds.), KM Munshi and N Chandrashekara Aiyer Bhartiya Vidya Bhavan