# Curriculum Structure & Syllabi

**(As per National Education Policy 2020)**

*of*

# B. Tech.

*in*

**Computer Science and Engineering**

**(w.e.f. 2021-22)**

Vision

Mission

Program Educational Objectives

Program Outcomes

Program Specific Outcomes

Overall Credit Structure

Curriculum

Syllabus

***Offered By***

**DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING**

**M. M. M. UNIVERSITY OF TECHNOLOGY**

**GORAKHPUR-273 010, UP**

**August 2022**

**CURRICULA & SYLLABI**
**B. Tech. Computer Science and Engineering**

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**Vision:**
To become a leader of education, research and innovation in the area of Computer Science and Engineering and to produce under graduates who are globally recognized as innovative and well-prepared computing professionals.

**Mission:**
1. To create, share and disseminate knowledge through research and education in the theory and application of computing.
2. To train the students in different aspects of computing discipline for enhancing, augmenting, and updating their technical skills
3. To inculcate the spirit of analysis, teamwork, innovation, and professionalism among the students

**Programme Educational Objectives (PEO)**

PEO-1 To inculcate the knowledge of the fundamentals of the mathematics, science & engineering disciplines for developing the ability to formulate, solve and analyze the problems of Computer Science & Engineering field and to provide them the skills for the pursuit of under-graduate studies, research and development and higher education.

PEO-2 To provide the understanding of the prerequisite of the software, technical aspects, and design for coming up with the novel engineering solutions and efficient product developments.

PEO-3 To assist the students in the pursuit of the successful career by adopting the ethical practices and social responsibility.

PEO-4 To provide students the technical as well as soft skills required by the national as well as international organizations.

PEO-5 To elevate cognizance in the students toward the unending learning and to inculcate the ethical and moral ways.

PEO-6 To give students the knowledge of the contemporary technologies, practical experiences, and possibilities in the field of Computer Science & Engineering and to provide the multidisciplinary knowledge to develop the team spirit and leadership qualities by working on multidisciplinary projects.

**Programme Outcome (POs)**

PO-1 The students will develop the ability towards the application of fundamental knowledge of computing, mathematics, algorithms and computer science & engineering precepts and rationales for developing the solutions of the critical engineering problems. (Rudimentary engineering analytical skills).

PO-2 The under graduating students will be able to model and carry out the experiments by using the fundamental knowledge of computer science & engineering discipline and derive the conclusions by analyzing and interpreting the data.

PO-3 The students will be able to analyze, design, implement and assess a computer-based information system, procedure, module, or program to fulfil the requirements along with the consideration of economic, social, privacy and reliability constraints. (Innovative skills)

PO-4 The students will be able to perform efficaciously in multi-disciplinary teams. (Team spirit)

PO-5 The students will develop the analytical skills to critically analyze, recognize, formulate,

and devise solutions to the engineering problems by using the adequate computing and engineering skills and knowledge. (Engineering problem solving skills)

PO-6 The students will have the awareness towards the professional, ethical practices, legal, security & social consequences, and obligation. (Professional integrity).

PO-7 The students will have the efficient speaking skill and written/interpersonal communication skills. (Oral & written communication skill)

PO-8 To impart the exhaustive education in the students required to understand and analyze the local and global consequences of computer science & engineering solutions ranging from individuals and organizations to society. (Engineering consequences assessment skills)

PO-9 The students will develop the realization of the requirement of and the ability to indulge in maintaining professional growth and unending learning. (Continuing education cognizance).

PO-10 The students will have the cognition towards the current issues and problems. (Societal awareness)

PO-11 The students will possess the ability to utilize the knowledge of innovative computing equipment's required for engineering tasks. (Pragmatic skills)

PO-12 The students will be able to apply the design and evolution precepts in the development of software and hardware computer systems of variable complications. (Software hardware interface).

**Programme Specific Outcome (PSOs):**

PSO1. Ability to be lifelong learner to adapt innovation.

PSO2. Ability to learn the best practices regarding ideating, innovating and to be able to attain successful career with globally employable capabilities.

PSO3. Ability to be open to international cultures and demands.

**Syllabus and Credit Structure for B. Tech. (Computer Science & Engineering)**

**(Session 2021-2022 and onwards)**

## OVERALL CREDIT STRUCTURE FOR B.TECH.(CSE) PROGRAM

| **Credit Courses** | | | |
|---|---|---|---|
| **Core Courses (CC)** | | **Electives Courses (EC)** | |
| **Category** | **Min. Credits** | **Category** | **Min. Credits** |
| Basic Sciences & Maths (BSM) | 20 | Program Electives (PE) | 12 |
| Engineering Fundamentals (EF) | 18 | Open Electives (OE) (Other Departments) | 3 |
| Professional Skill (PS) | 4 | | |
| Program Core (PC) | 64 | Humanities & Social Science elective (HSSE) | 2 |
| Management (M) | 4 | | |
| Humanities & Social Science (HSS) | 4 | | |
| Project (P) | 5/9 | | |
| Seminar (S) | 2 | | |
| Industrial Practice (IP)/ Industrial Elective (IE) | 12/8 | | |
| Program link basic science and engineering courses (PLBSE) (To be decided by the department) | 17 | | |
| **Sub-total** | **150** | **Sub-total** | **17** |
| **Grand Total** | **167** | | |
| **1. Extracurricular Activities Courses (ECA)**<br><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 | | | **Non-Credit** |
| **2. Audit Courses (AC)**<br><br>Two of the Audit Courses are compulsory | | | **Non-Credit** |
| **3. Industrial Training (Mandatory)** | | | **Non-Credit** |

| **Minor Degree Courses (Optional) from any department** | **Credits** |
|---|---|
| Department Minor (DM) Courses | 18-20 |

**Semester wise Credit Structure for B. Tech. CSE**

| Category / Semesters | I | II | III | IV | V | VI | VII | VIII | Total |
|---|---|---|---|---|---|---|---|---|---|
| Basic Sciences & Maths (BSM) | 4 | 8 | 4 | 4 | - | - | - | - | **20** |
| Engineering Fundamentals (EF) | 7 | 7 | 4 | - | - | - | - | | **18** |
| Professional Skill (PS) | 2 | 2 | - | - | - | - | - | | **4** |
| Program Core (PC) | - | - | 10 | 17 | 13 | 12 | 12 | | **64** |
| Management (M) | - | - | - | - | 2 | 2 | - | | **4** |
| Humanities & Social Science (HSS) | 2 | - | 2 | - | - | - | - | | **4** |
| Humanities & Social Science Elective (HSSE) | 2 | - | - | - | - | - | - | | 2 |
| Project (P) | - | - | - | - | - | 2 | 3 | 4 | **5/9** |
| Seminar (S) | - | - | - | - | - | 2 | - | | **2** |
| Industrial Practice (IP)/ Industrial Elective (IE) | - | - | - | - | - | - | - | 12/8 | **12/8** |
| Program link basic science and engineering courses (PLBSE) (To be decided by the department) | 2 | 4 | 2 | 4 | 5 | 0 | - | | **17** |
| Program Electives (PE) | - | - | - | - | 4 | 4 | 4 | | **12** |
| Open Electives (OE) (Other Departments) | - | - | - | - | - | - | 3 | | **3** |
| **Total** | **19** | **21** | **22** | **25** | **24** | **22** | **22** | **12** | **167** |

**First Year, Semester I**

| S. No. | Category | Paper Code | Subject | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| 1. | BSM | BSM-104 | Linear Algebra and Differential Equations | 3 | 1 | 0 | 4 |
| 2. | EF | BEE 101 | Fundamental of Electrical Engineering | 3 | 1 | 2 | 5 |
| 3. | HSS | BHM-101 | Professional Communication | 2 | 0 | 0 | 2 |
| 4. | PS | BCS-102 | Web Designing-1 | 1 | 0 | 2 | 2 |
| 5. | EF | BCS-103 | Computer Troubleshooting & Maintenance | 0 | 0 | 4 | 2 |
| 6. | PLBSE | BSM-144 | Environment and Ecology | 2 | 0 | 0 | 2 |
| 7. | HSSE | BHM-113 | Industrial Psychology | 2 | 0 | 0 | 2 |
| | | | **Total** | **13** | **2** | **8** | **19** |
| 8. | ECA-I | ECA-100 | Induction Program | - | - | - | **0** |

**First Year, Semester II**

| S. No. | Category | Paper Code | Subject | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| 1. | BSM | BSM-156 | Applied Probability and Statistics | 3 | 1 | 0 | 4 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2. | EF | BCS-151 | Introduction to C Programming | 3 | 1 | 2 | 5 |
| 3. | BSM | BSM-179 | Quantum Physics and Nanomaterials | 3 | 1 | 0 | 4 |
| 4. | PS | BCS-152 | Web Designing-2 | 1 | 0 | 2 | 2 |
| 5. | EF | BCS-153 | IT Tools and Workshop-1 | 0 | 0 | 4 | 2 |
| 6. | PLBSE | BEC-154 | Basic Electronic Components and Circuits | 3 | 0 | 2 | 4 |
| | | | **Total** | **13** | **3** | **10** | **21** |
| 7. | ECA-II | | Induction Program | - | - | - | **0** |

**Second Year, Semester III**

| S. No. | Category | Paper Code | Subject | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| 1. | BSM | BSM-202 | Discrete Mathematics | 3 | 1 | 0 | 4 |
| 2. | EF | BCS-201 | Digital Logic and Design | 3 | 0 | 2 | 4 |
| 3. | HSS*** | BHM-202 | Cyber Ethics and IPR | 2 | 0 | 0 | 2 |
| 4. | PC | BCS-202 | Principles of Data Structures | 3 | 1 | 2 | 5 |
| 5. | PC | BCS-203 | Object Oriented Programming | 3 | 1 | 2 | 5 |
| 6. | PLBSE | BCS-204 | IT Tools and Workshop-2 | 0 | 0 | 4 | 2 |
| | | | **Total** | **14** | **3** | **10** | **22** |
| 7. | AC | AUC-01-AUC-15 | Audit Course | 1/2 | - | - | 0 |
| 8. | ECA-III | | | - | - | - | 0 |

**Second Year, Semester IV**

| S. No. | Category | Paper Code | Subject | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| 1. | BSM | BSM-253 | Optimization Techniques | 3 | 0 | 2 | 4 |
| 2. | PC | BCS-251 | Database Management Systems | 3 | 0 | 2 | 4 |
| 3. | PC | BCS-252 | Theory of Computation | 3 | 1 | 0 | 4 |
| 4. | PC | BCS-253 | Design & Analysis of Algorithms | 3 | 1 | 2 | 5 |
| 5. | PC | BCS-254 | Computer Organization and Architecture | 3 | 0 | 2 | 4 |
| 6. | PLBSE | BEC-256 | Signal and Systems | 3 | 1 | 0 | 4 |
| | | | **Total** | **18** | **3** | **8** | **25** |
| 7. | ECA-IV | | | - | - | - | 0 |
| 8. | AC | AUC-01-AUC-15 | Audit Course | 1/2 | - | - | 0 |
| 9. | DM1 | SCS-211 | Subject-1 Introduction to Data Science | 3 | 0 | 0 | 3 |
| | DM2 | SCS-221 | Subject-1 | 3 | 0 | 0 | 3 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | Introduction to Security of Cyber-Physical Systems | | | | |
| | DM3 | SCS-231 | Subject-1 Computer Graphics for Virtual Reality | 3 | 0 | 0 | 3 |

**Third Year, Semester V**

| S. No. | Category | Paper Code | Subject | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| 1. | M | BHM-301 | Engineering & Managerial Economics | 2 | 0 | 0 | 2 |
| 2. | PC | BCS-301 | Principles of Operating Systems | 3 | 0 | 2 | 4 |
| 3. | PC | BCS-302 | Principle of Compiler Design | 3 | 1 | 2 | 5 |
| 4. | PC | BCS-303 | Computer Networks | 3 | 0 | 2 | 4 |
| 5. | PE1 | BCS-326-329 | Program Elective-1 | 3 | 1 | 0 | 4 |
| 6. | PLBSE | BEC-305 | Microprocessor and Microcontroller | 3 | 1 | 2 | 5 |
| | | | **Total** | **17** | **3** | **8** | **24** |
| 7. | ECA-V | | | - | - | - | 0 |
| 8. | DM1 | SCS-312 | Subject-2 Computational Data analytics | 3 | 0 | 2 | 4 |
| | DM2 | SCS-322 | Subject-2 Ubiquitous Sensing, Computing and Communication | 3 | 0 | 2 | 4 |
| | DM3 | SCS-232 | Subject-2 Concepts of Virtual and Augmented Reality | 3 | 0 | 2 | 4 |

**Third Year, Semester VI**

| S. No. | Category | Paper Code | Subject | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| 1. | M | BHM-351 | Business Management | 2 | 0 | 0 | 2 |
| 2. | PC | BCS-351 | Artificial Intelligence | 3 | 1 | 0 | 4 |
| 3. | PC | BCS-352 | Software Engineering | 3 | 1 | 0 | 4 |
| 4. | PC | BCS-353 | Parallel & Distributed Programming | 3 | 0 | 2 | 4 |
| 5. | PE2 | BCS-376-379 | Program Elective-2 | 3 | 1 | 0 | 4 |
| 6. | P | BCS-370 | Project Part-I | 0 | 0 | 4 | 2 |
| 7. | S | BCS-380 | Seminar | 0 | 0 | 4 | 2 |
| | | | **Total** | **14** | **3** | **10** | **22** |
| 8. | ECA-VI | | | - | - | - | 0 |
| 9. | DM1 | SCS-313 | Subject-3 Web Data Mining | 3 | 0 | 2 | 4 |
| | DM2 | SCS-323 | Subject-3 Embedded Systems for IoT | 3 | 0 | 2 | 4 |
| | DM3 | SCS-333 | Subject-3 Scientific and Engineering Data Visualisation | 3 | 0 | 2 | 4 |

**Final Year, Semester VII**

| S. No. | Category | Paper Code | Subject | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| 1. | PC | BCS-401 | Fault Tolerance Analysis | 3 | 1 | 0 | 4 |
| 2. | PC | BCS-402 | Cryptography and Information Security | 3 | 1 | 0 | 4 |
| 3. | PC | BCS-403 | Introduction to Functional and Logic Programming | 3 | 0 | 2 | 4 |
| 4. | PE3 | BCS-426-429 | Program Elective-3 | 3 | 1 | 0 | 4 |
| 5. | OE | OCS-401-405 | OE (PYTHON Programming) (This course is for students of other departments. However, CSE students will go through open elective run by other department as per their choices) | 2 | 1 | 0 | 3 |
| 6. | P | BCS-440 | Project Part-II | 0 | 0 | 6 | 3 |
| | | | **Total** | **14** | **4** | **8** | **22** |
| 7. | ECA-VII | | | - | - | - | 0 |
| 8. | DM-1 | SCS 415 | Subject-4 Analysing, Visualizing and Applying data science with python | 3 | 1/0 | 0/2 | 4/5 |
| | DM-2 | SCS-425 | Subject-4 IoT with Arduino, ESP, and Raspberry Pi | 3 | 1/0 | 0/2 | 4/5 |
| | DM-3 | SCS-435 | Subject-4 Mobile VR and AI in Moduley | 3 | 1/0 | 0/2 | 4/5 |

**Final Year, Semester VIII**

| S. No. | Category | Paper Code | Subject | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| 1. | IP | ICS-400 | Industrial Practices | 0 | 0 | 24 | 12 |
| | **Without Industrial Practices (IP)** | | | | | | |
| 2. | MP | BCS-480 | Minor project | 0 | 0 | 8 | 4 |
| 3. | IE | ICS-401-ICS 404 | Industrial Elective-1 | 3 | 1 | 0 | 4 |
| 4. | IE | ICS-405-ICS 409 | Industrial Elective-2 | 3 | 1 | 0 | 4 |
| | | | **Total** | **6** | **2** | **8/24** | **12** |
| 5. | DM-1 | SCS-415 | Research Project* | 0 | 0 | 4 | 2 |
| | DM-2 | SCS-425 | Research Project* | 0 | 0 | 4 | 2 |
| | DM-3 | SCS-435 | Research Project* | 0 | 0 | 4 | 2 |

| Paper Code | Program Elective-1 |
|---|---|
| BCS-326 | 1. Digital Image Processing |

| | |
|---|---|
| BCS-327<br>BCS-328<br>BCS-329 | 2. Advanced Programming Techniques<br>3. Data Warehouse & Data Mining<br>4. Applied Graph Theory |

| **Paper Code** | **Program Elective-2** |
|---|---|
| BCS-376<br>BCS-377<br>BCS-378<br>BCS-379 | 1. Analytics and Systems of Big Data<br>2. Introduction to Machine Learning<br>3. Embedded System<br>4. Computational Complexity |

| **Paper Code** | **Program Elective-3** |
|---|---|
| BCS-426<br>BCS-427<br>BCS-428<br>BCS-429 | 1. Game Theory<br>2. Computer Vision: Foundation and Applications<br>3. High Performance Computing Architecture<br>4. Dependable Computing |

| **Paper Code** | **Industrial Elective 1** |
|---|---|
| ICS-401<br>ICS-402 | 1. Software Quality Management<br>2. Software Reliability |
| **Paper Code** | **Industrial Elective 2** |
| ICS-405<br>ICS-406 | 1. Software Verification and Validation<br>2. Modelling and Simulation |

**List of Audit Courses (AC)**

| S.No. | Subjects | Codes |
|---|---|---|
| 1. | Constitution of India | AUC01 |
| 2. | Indian Culture and Heritage | AUC02 |
| 3. | Indian Architecture | AUC03 |
| 4. | Indian Festivals | AUC04 |
| 5. | Vaidic Mathematics | AUC05 |
| 6. | Astronomy | AUC06 |
| 7. | Arts of India | AUC07 |
| 8. | Intellectual Property Right | AUC08 |
| 9. | Human Rights | AUC09 |
| 10. | Logical Research | AUC10 |
| 11. | Professional Ethics | AUC11 |
| 12. | Environmental Law | AUC12 |
| 13. | Health Law | AUC13 |
| 14. | National Cadet Corps | AUC14 |
| 15. | Basics of Human Health and preventive medicines | AUC15 |

**Note: Detailed syllabus of Audit Courses (AC) is attached as annexure-01.

**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 |

| ECA-III | | | | | | |
|---|---|---|---|---|---|---|
| S. No. | Branch | Category | Subject Name | Subject Code | Hours/ Week | Credit |
| 1. | Open to all Branches | ECA | Skill Development-II | ECA-201 | 2 | 0 |
| 2. | Open to all Branches | ECA | Unity and Discipline (NCC)- II | ECA-221 | 2 | 0 |
| 3. | Open to all Branches | ECA | Unity and Discipline (NSS)-II | ECA-222 | 2 | 0 |
| 4. | Open to all Branches | ECA | Games & Sports-II | ECA-231 | 2 | 0 |
| 5. | Open to all Branches | ECA | Cultural, Art & Literary-II | ECA-232 | 2 | 0 |

| ECA-IV | | | | | | |
|---|---|---|---|---|---|---|
| S. No. | Branch | Category | Subject Name | Subject Code | Hours /Week | Credit |
| 1. | Open to all Branches | ECA | Skill Development-III | ECA-251 | 2 | 0 |
| 2. | Open to all Branches | ECA | Unity and Discipline (NCC)- III | ECA-271 | 2 | 0 |
| 3. | Open to all Branches | ECA | Unity and Discipline (NSS)- III | ECA-272 | 2 | 0 |
| 4. | Open to all Branches | ECA | Games & Sports-III | ECA-281 | 2 | 0 |
| 5. | Open to all Branches | ECA | Cultural, Art & Literary-III | ECA-282 | 2 | 0 |

| ECA-V | | | | | | |
|---|---|---|---|---|---|---|
| S. No. | Branch | Category | Subject Name | Subject Code | Hours/Week | Credit |

| | | | | | | |
|---|---|---|---|---|---|---|
| 1. | Open to all Branches | ECA | Skill Development-IV | ECA-301 | 2 | 0 |
| 2. | Open to all Branches | ECA | Unity and Discipline (NCC)- IV | ECA-321 | 2 | 0 |
| 3. | Open to all Branches | ECA | Unity and Discipline (NSS)-IV | ECA-322 | 2 | 0 |
| 4. | Open to all Branches | ECA | Games & Sports-IV | ECA-331 | 2 | 0 |
| 5. | Open to all Branches | ECA | Cultural, Art & Literary-IV | ECA-332 | 2 | 0 |

**ECA-VI**

| S. No. | Branch | Category | Subject Name | Subject Code | Hours/ Week | Credit |
|---|---|---|---|---|---|---|
| 1. | Open to all Branches | ECA | Skill Development-V | ECA-351 | 2 | 0 |
| 2. | Open to all Branches | ECA | Games & Sports-V | ECA-381 | 2 | 0 |
| 3. | Open to all Branches | ECA | Cultural, Art & Literary-V | ECA-382 | 2 | 0 |

**ECA-VII**

| S. No. | Branch | Category | Subject Name | Subject Code | Hours/ Week | Credit |
|---|---|---|---|---|---|---|
| 1. | Open to all Branches | ECA | Skill Development-VI | ECA-401 | 2 | 0 |
| 2. | Open to all Branches | ECA | Games & Sports-VI | ECA-431 | 2 | 0 |
| 3. | Open to all Branches | ECA | Cultural, Art & Literary-VI | ECA-432 | 2 | 0 |

**Note: Detailed syllabus of Extra Curricular Activity (ECA) Courses is attached as annexure-02.

## FRAMEWORK FOR THE IMPLEMENTATION OF MOOC COURSES IN B. TECH. PROGRAMME

As per the guidelines given by AICTE via GO. No. AICTE/P&AP/SWAYAM/2016 dated 17th August 2016, M. M. M. University of Technology Gorakhpur has decided to implement 20% subjects/courses from MOOCs from SWYAM portal in the curricula of B. Tech programme offered by University from the session 2022-23 onwards. The framework for incorporating the MOOC courses in the curricula of B. Tech programme is given below.

1. The MOOC Courses of Swayam portal will be offered in:
   (a) B. Tech-IInd semester for HSSE Courses of Humanities & Management Science Department.
   (b) B.Tech-IIIrd and IVth semester for Audit Courses (AC) of Humanities & Management Science Department.
   (c) B.Tech-Vth, VIth & VIIth semester as Program Elective (PE) Course of respective Engineering Departments.
   (d) B. Tech-VIIIth semester for Industrial Elective (IE) Course of respective Engineering Departments.
2. It has been indicated in the above GO of AICTE that MOOC Courses of Swayam portal will be announced on 1st June for odd semester and 1st November for the even semester every year. After the announcement of the subjects on Swayam portal, each department of University will identify the subjects against each of the MOCC courses in respective semester from the Swayam portal and send the list of identified subjects to the office of Dean UGS & E after the approval of BOS of respective department. Dean UGS & E will notify the same and notification will be uploaded on the University website well in advance so that students may get registered in the subject in time.
3. Concern department will nominate one of its faculty as a departmental MOOCs Coordinator for each of the MOOC Course and same will be intimated to Dean UGS & E along with the teaching load of the department. The departmental MOOCs Coordinator will be responsible for the registration, assignment submission, term end examination and result of the students who have opted MOOC courses.
4. For the reimbursement of MOOCs registration fee, student will write an application addressed to Dean UGS & E through the concerned Head of Department and departmental MOOCs Coordinator along with the receipt of MOOCs registration fee and admit card/hall ticket. The application of student for the reimbursement of fee will be entertained only if it is recommended by concerned MOOCs Coordinator and Head of Department.
5. Credit will be defined as per clause 6.1.5.5 of B. Tech ordinance for the MOOC Courses on Swayam portal in which credit is not mentioned,
6. If better practical facility is available at virtual lab of different premier institution of national and international importance, then the practical facility of that subject could be availed through the virtual lab. In any practical based subject, if practical lab is not assigned and better practical facility is available on virtual lab then it may be conducted on the virtual lab and one credit will be added through the BOS of concerned department.
7. The evaluation scheme for practical based subjects conducted through virtual lab will be same as the existing evaluation scheme of practical courses of the University.

## Syllabus

**BSM-104 Linear Algebra and Differential Equations**

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

1. Use of basic differential operators in various engineering problems.
2. To understand the concept of convergence and divergence of sequences.
3. Solve linear system of equations using matrix algebra.
4. Application of ordinary differential equations in various engineering problem.
5. To know the applications of double and triple integration in finding the area and volume.
6. To inculcate the habit of mathematical thinking and lifelong learning.

**Topics Covered**

**UNIT-I** 9

**Sequences and Series of Real Numbers** Sequence of real numbers, convergence of sequences, bounded and monotone sequences, convergence criteria for sequences of real numbers, Cauchy sequences, subsequences, Bolzano-Weierstrass theorem. Series of real numbers, absolute convergence, tests of convergence for series of positive terms, comparison test, ratio test, and root test; Leibniz test for convergence of alternating series.

**UNIT-II** 9

**Linear Algebra:** 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, Eigenvectors, Cayley-Hamilton theorem, Diagonalization of matrices.

**UNIT-III** 9

**Functions of Two or Three Real Variables:** Limit, continuity, partial derivatives, differentiability, Taylors Theorem, maxima, and minima. **Integral Calculus:** Double and triple integrals, change of order of integration, change of variables, calculating surface areas and volumes using double integrals, Dirichlet's Integral, calculating volumes using triple integrals.

**UNIT-IV** 9

**Differential Equations:** 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.

**Books & References**


1. B.S. Grewal: Higher Engineering Mathematics; Khanna Publishers
2. Erwin kreyszig: Advanced Engineering Mathematics, John Wiley & Sons.
3. R. K. Jain and Iyenger: Advanced Engineering Mathematics, Narosa Publications.

4. B.V. Ramana: Higher Engineering Mathematics, Tata Mc. Graw Hill Education Pvt. Ltd.,

**Course Code: BEE-101/ 151** **Fundamentals of Electrical Engineering**

| | | |
|---|---|---|
| **Course category** | : | Engineering Fundamentals (EF) |
| **Pre-requisite Subject** | : | NIL |
| **Contact hours/week** | : | Lecture: 3, Tutorial: 1, Practical: 2 |
| **Number of Credits** | : | 5 |
| **Course Assessment methods** | : | Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce and two minor tests and one major theory & practical examination. |
| **Course Objectives** | : | **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.<br>**2.** To demonstrate and understand the basic concepts of analysis of simple DC and AC circuits, Magnetic Circuits, Transformers and Electrical Machines. |

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

1. Understand the basic properties of electrical elements, and solve problem based on basic electrical circuits & DC network theorems.
2. Understand the fundamental behaviour of AC circuits and solve AC circuit problems.
3. Apply the knowledge gained to explain the behaviour of the circuit at series & parallel resonance of circuit & the effect of resonance.
4. Understand 3 phase balanced and unbalanced, star and delta connected supply and load and to measure power in 3 phase circuits
5. Explain construction and working principle of transformer with background of magnetic circuits.
6. Classify and compare different types of Electrical machines.

**Topic Covered**

**UNIT I**

**D C Circuit Analysis and Network Theorems:**

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. **9**

**UNIT II**

**Steady- State Analysis of Single-Phase AC Circuits:** **9**

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

**UNIT III**

**Magnetic Circuit & Single-Phase Transformers:** **9**

Magnetic circuit, concepts, analogy between electric & magnetic circuits, B-H curve, Hysteresis, and eddy current losses.

Single Phase Transformer: Principle of operation, Construction, EMF equation, Power losses, Efficiency, O.C & S.C Test and Introduction to auto transformer.

**UNIT IV**

**Electrical Machines:** **9**

Concept of electromechanical energy conversion DC machines: Types, EMF equation of generators and torque equation of motor, Characteristics, and applications of DC Generators & motors.

Single Phase Induction motor: Principle of operation and introduction to methods of starting, applications.

Three Phase Induction Motor: Types, Principle of operation, Torque-slip characteristics, Applications

***EXPERIMENTS***

1. Verification of Kirchhoff's Law.
2. Verification of Norton's Theorem.
3. Verification of Thevenin's Theorem.
4. Verification of Superposition Theorem.
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.
9. To perform O.C. and S.C. test of a single-phase transformer.
10. To draw the magnetization characteristics of separately excited dc motor.
11. To perform the external load characteristics of dc shunt motor.

**Text and Reference Books:**

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.
3. Electrical and Electronics Technology, Edward Hughes; Pearson.
4. Basic Electrical Engineering, D P Kothari, I.J. Nagarath; Tata McGraw Hill
5. Electrical Technology, B. L. Thareja and A. K. Thareja; S. Chand.

**Course Code: BHM-101/151** **PROFESSIONAL COMMUNICATION**

| | | |
|---|---|---|
| **Course category** | : | HSS |
| **Pre-requisite Subject** | : | None |
| **Contact hours/week** | : | Lecture: 2, Tutorial: 0, Practical: 0 |
| **Number of Credits** | : | 02 |
| **Course Assessment methods** | : | Continuous assessment through attendance, home assignments, two minor tests and one major theory examination. |
| **Course Objectives** | : | To sensitize the students to understand the role & importance of communication for personal & professional success and enable learners to exhibit knowledge, skills, and judgment in and around human communication that facilitate their ability to work collaboratively with others in an interpersonal environment. |
| **Course Outcomes** | : | The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course. |

1. Use of various facets of communication skills, such as, Reading, Writing, Listening and speaking skills.
2. To identify, formulate and solve the real-life problems with positive attitude.
3. To inculcate the habit of learning and developing the communication and soft skills by practice.
4. To create an amicable ambience to make them learn the different part of English language with the correction of the language.
5. Enhancing word power by counselling scientific literature.
6. Focusing on effortless speaking and writing.

**Topics Covered**

**UNIT-I** 6

**VERBAL COMMUNICATION:**

Received Pronunciation; how to activate passive vocabulary; Technical/non-technical and Business Presentations; questioning and answer skills; soft skills for professionals; role of body postures, movements, gestures, facial expressions, dress in effective communication; Information/ Desk/ Front Office/ Telephone conversation; how to face an interview/press conference; Group discussions, debates, elocution.

**UNIT-II**

**READING COMPREHENSION** 6

Skimming and Scanning; factual and inferential comprehension; prediction; guessing meaning of words from context; word reference; use and interpretation of visuals and graphics in technical writing.

**UNIT-III**

**WRITTEN COMMUNICATION:** 6

Note Making and Note Taking; summarizing; invitation, advertisement, agenda, notice and memos; official and commercial letters; job application; resume and curriculum vitae; utility, technical, project and enquiry reports; paragraph writing: General – Specific, Problem – Solution, Process – Description, Data – Comment.

**UNIT-IV**

**SHORT ESSAYS:** 6

Description and Argument; comparison and contrast; illustration; using graphics in writing: tables and charts, diagrams and flow charts, maps and plans, graphs; how to write research paper; skills of editing and revising; skills of referencing; what is a bibliography and how to prepare it.

**Text and Reference Books**


1. Bansal, R.K. & Harrison J.B., (1972) *Spoken English*, Orient Longman, India.
2. Chauhan, Narender Kr. & Singh, Sudhir N., (2013) *Formal Letters*, Pankaj Publication International, New Delhi.
3. Chhabra T.N., (2019) *Business Communication*, Sun India Publication, New Delhi.
4. Dixon Robert J., (1986) *Complete Course in English*, Prentice Hall of India, New Delhi.
5. Jones, Daniel., (2012) *Cambridge English Pronouncing Dictionary*, 18th Edition, Paperback, CUP, India.
6. Lewis, Norman, (2015) *Word Power Made Easy*, Penguin India.


**BHM-113: INDUSTRIAL PSYCHOLOGY**

**Course Category**: Humanities & Social Science Elective (HSSE)

**Pre-requisite Subject**: Nil

**Contact hours/week**: 2 hours per week

**No of Credits**: Lecture: 2, Tutorial:0, Practical: 0

**Course Assessment Methods**: Continuous assessment through attendance, home assignments, quizzes, and two minor tests and One Major Theory Examination.

**Course Objectives:** This course provides the knowledge and understanding of

a. Basic concepts of industrial psychology
b. Stress management at job place
c. Working and engineering environment
d. Appraisal system and leadership quality

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

1. Use of various facets of psychology,

2. Scientific management and human relations
3. To identify, formulate and solve the real-life problems with positive attitude.
4. To inculcate the habit of learning and developing the industrial problems from psychological eyes.
5. Performance of management and appraisal system
6. Leadership quality

**UNIT-I**

Introduction to Industrial Psychology and its basic concepts Nature, Importance and scope of Industrial Psychology, Scientific management, Time and motion study and human relations school

**6**

**UNIT-II**

Individual in workplace Motivation and job satisfaction, Stress management, Organisational culture, Leadership and group dynamic.

**6**

**UNIT-III**

Work environment, Recruitment and selection Engineering Psychology, Fatigue and boredom, Work environment, Accident and safety, Job analysis, Recruitment and selection, Psychological tests.

**6**

**UNIT-IV**

Performance management and training Performance appraisal, Importance and Methods of Performance appraisal, Training and development- Concepts and Benefits to the organization.

**6**

**References**


1. Aamodt, M. G. (2007) *Industrial/Organization Psychology: An Applied Approach* (5th Edition) Wadsworth /Thompson: Belmont, C. A.
2. Aswathappa K. (2008) *Human Resource Management (Fifth edition)* New Delhi: Tata McGraw Hill.
3. Blum & Naylor (1962) *Industrial Psychology. Its Theoretical & Social Foundations,* CBS Publication.
4. Despandey, Archana., (2010) *Industrial Psychology*, Sun India Publications, New Delhi.
5. Miner, J. B. (1992). *Industrial/Organizational Psychology*, N Y: McGraw Hill.


**BCS-102** **Web Designing-1**

| | |
|---|---|
| Course category: | Professional Skill (PF) |
| Pre-requisite Subject: | NIL |
| Contact hours/week: | Lecture: 1, Tutorial: 0, Practical: 2 |
| Number of Credits: | 2 |
| Course Assessment methods: | Continuous Assessment through Two Tests, Teacher Assessment (Quiz, Tutorial, Assignment, |

Attendance), Practical Work & Viva-voce, and One Major Theory & One Practical Examinations.

**Course Objective:** Web designing-I syllabus contains a basic introduction to familiarize students with the basics of designing a website to its tools, software applications and themes. Here are the key topics covered under the introduction to web designing.

1. How to design a website
2. Creating different themes for different layouts
3. How to design the look and feel of a website
4. How to create and design banners, advertisements, etc.

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

1. Understand principle of Web page design and about types of websites.
2. Visualize and Recognize the basic concept of HTML and application in web designing.
3. Recognize and apply the elements of Creating Style Sheet (CSS).
4. Understanding the basic concept of Java Script and its application.
5. Understanding the basic concept Angular JS.
6. Learning about the tools and techniques of web design covers using software applications

**UNIT-I** **3**

**HTML:** Introduction to web site, Domains and Hosting, Responsive Web Designing, Types of Websites: Static and Dynamic, HTML5, Basic structure of an HTML document, HTML Tags: Heading, Paragraphs, Line Breaks, Text, Lists, Tables, Frames, Hyperlinks, Images, Multimedia, Forms, and their controls.

**UNIT-II** **3**

**Creating Style Sheet (CSS):** Creating Style Sheet, CSS Properties, CSS Styling, CSS Id and Class, Box Model, CSS Advanced: Grouping, Dimension, Display, Positioning, Floating, Align, Pseudo class, Navigation Bar, Image Sprites, Attribute sector, CSS Colour. Basics of responsive web design using Bootstrap.

**UNIT-III** **3**

**Java Script:** Introduction to Java Script, Variables, Operators, Conditions Statements, Loops, Popup Boxes, Events, Arrays, Objects, Functions in JS, Form Validation and regex, JSON.

**UNIT-IV** **3**

**Angular Java Script:** Introduction to AngularJS, MVC Architecture, Expressions and Data Biding, Directives, Controllers, Filters, Forms, Modules, Introduction to Single page application.

**EXPERIMENTS**

1. To create a simple html file to demonstrate the use of different tags.
2. To create an html file to link to different html page which contains images, tables, and also link within a page.
3. To create an html page with different types of frames such as floating frame, navigation frame & mixed frame.
4. To create a registration form as mentioned below.
5. Procedure: Create an html page named as “registration.html”
    i. set background colors
    ii. use table for alignment

iii. provide font colors& size

6. To create an html file by applying the different styles using inline, external & internal style sheets.
7. Create a sample HTML form using bootstrap.
8. To write a Javascript program to define a user defined function for sorting the values in an array.
9. To create an html page to explain the use of various predefined functions in a string and math object in java script.
10. To create an html page to explain the use of various predefined functions in a array & Date object in Javascript.
11. To create an html page to demonstrate exception handling in javascript
12. To display the calendar using javascript code by getting the year from the user.
13. To create a html registration form and to validate the form using javascript code.
14. To create a html file. To open new window from the current window using javascript.
15. To create an html page to change the background color for every click of a button using javascript.
16. To create an html page with 2 combo boxes populated with month & year, to display the calendar for the selected month & year from combo box using javascript.
17. To create a html page to display a new image & text when the mouse comes over the existing content in the page.
18. Create a single page application using concepts of Angular JS.

**Textbooks:**


1. Steven M. Schafer, "HTML, XHTML, and CSS Bible, 5ed", Wiley India
2. Ian Pouncey, Richard York, "Beginning CSS: Cascading Style Sheets for Web Design", Wiley India
3. Douglas Crockford, JavaScript: The Good Parts: The Good Parts. O'Reilly Media, Inc.
4. Brad Green, Shyam Seshadri, AngularJS, O'Reilly Media, Inc


**BCS –103 Computer Troubleshooting and Maintenance**

| | |
|---|---|
| Course category: | Engineering Fundamental (EF) |
| Pre-requisite Subject: | NIL |
| Contact hours/week: | Lecture: 0, Tutorial: 0, Practical: 4 |
| Number of Credits: | 2 |
| Course Assessment methods: | Continuous Assessment through Teacher Assessment (Quiz, Tutorial, Assignment, Attendance), Practical Work & Viva-voce, and One Practical Examinations. |

**Course Objective:** The main objective of this course is to introduce PC maintenance, upgrading, repairing. The students

1. Can join industry as Technician and will progress further as Senior Technician, Supervisor and can rise to the level of Manager.
2. Can become Entrepreneur in the related field.
3. Can join Apprenticeship programs in different types of industries.

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

1. Understand basics of hardware components.
2. Acquire knowledge of finding faults in components
3. Install, configure, and maintain various components in computer system and peripherals.
4. Diagnose faults of different component
5. Repair and maintain computer system and its peripherals.
6. helps to fully understand the family of computers that has grown from the original IBM PC, including all PC-compatible systems.

**EXPERIMENTS**

The students will perform following experiments to get familiar with Computer.

1. Disassemble a personal computer and assemble the same system again. Boot the system and observe the procedure of assembling a computer system.
2. Observe various connectors, ports back and front side of the computer. Write their purpose and specifications. (e.g., Power, PS/2 keyboard and mouse, Serial and parallel, USB, VGA, LAN, Audio & microphone, Firewire, HDMI, games, SATA etc.)
3. Identify BIOS settings, demonstrate starting BIOS, identify how to disable unused devices to decrease security risks. Change booting of computer with different secondary storage CD, HDD, USB etc.
4. Perform low level and high-level formatting of Hard Disk. Format the given Hard Disk using any one technique and create three partitions, two for operation systems and one for data. Install OS of different types. Also search for various data recovery software apply on pen drive/HDD.
5. Observe different types of printers (dot matrix, inkjet & laser, multifunction). Install driver and interface the printers with PC/Laptop on any operating system (connect the printer to one PC directly using USB/Serial/Parallel ports as per the availability; test the functioning of the printer.)
6. Learn the interfacing, installation and working of various devices such as scanner, projector, web cam etc. Connect all these devices with the given PC, install & test them.
7. Recognize common symptoms associated with diagnosing and troubleshooting PCs and utilize Windows built-in diagnostic tools.
   a. Identify general troubleshooting techniques and strategies
   b. Utilize scandisk, control panel, boot-up menu, and start-up disk as diagnostic tools.
   c. Access Microsoft knowledge base on the internet to solve common problems.
   d. Identify the common problems associated with shutdown, configuration, and cabling.
   e. Identify problems associated with heating and cooling of the internal components.
   f. Identify problems with installing internal devices such as hard drive, tape drives, or CD-ROM drive.
   g. Recognize and interpret the meaning of common error codes and start-up messages.
   h. Recognize windows-specific printing problems and corrections.
   i. Identify the various problems associated with network using diagnostic tools
   j. Learn disk and device driver management.

8. Define registry file operation and maintenance. Using various tools available for the registry. Operate and maintain registry file. Describe registry file operations & demonstrate proper registry file maintenance practices.
9. Perform computer maintenance and preventative maintenance functions.
   a. Perform physical cleaning (internal and external) of personal computer.
   b. Demonstrate how to adjust basic performance settings.
   c. Perform hard drive file system maintenance.
   d. Identify anti-virus software and applications
10. Introduction to Virtualization. Demonstration of installation and working on Virtual Box.
11. Introduction to windows networking, data sharing, printer sharing, remote desktop connection using Windows RDC, creating shared folders for each user, assigning access rights, and changing ownership for shared folders using file server wizard.

| | |
|---|---|
| **BSM-144** | **Environment and Ecology (CS)** |
| **Course category** | Basic Sciences & Maths (BSM) |
| **Pre-requisite Subject** | NIL |
| **Contact hours/week** | Lecture : 2, Tutorial : 0, Practical: 0 |
| **Number of Credits** | 2 |
| **Course Assessment methods** | Continuous assessment through, attendance, home assignments, quizzes, Minor and Major Theory Examination. |
| **Course Objectives** | ➢ Solve environmental engineering problems and persue higher studies using solid foundation in Chemistry and environmental science.<br>➢ Design and operate various environmental systems in industries as well as higher studies through interactive education |
| **Course Outcomes** | The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course. |

1. Students will acquire basic knowledge about Environment, which allows students to gain qualitative and quantitative skills.
2. Students will aware of environmental pollution and control methods along with quality standards of air, water etc along with waste management.
3. Students will able to give systematic account of natural resources their use and environmental problems due to overexploitation.
4. Students will acquire basic knowledge about the chemical reactions taking place in the environment.
5. To acquire awareness for ethical principle of environment.
6. To gain knowledge as a leader in multidisciplinary areas.

**Topics Covered**

**UNIT-I** **6**

Basic concept of Environmental chemistry, Introduction to atmospheric chemistry, Layers of the atmosphere and their chemical composition, chemistry of gaseous and particulate pollutants, Ozone and its control, Green House Effect.

UNIT-II **6**

The Chemistry of Natural Waters, Oxidation-Reduction Chemistry in Natural Waters, Ion Concentrations in Natural and potable Water, Water Pollution and Purification of Water, Water Disinfection, Ground water: Its Supply, Chemical Contamination, and Remediation The Chemical Contamination and Treatment of Wastewater and Sewage .

UNIT-III **6**

Toxic Heavy Metals, Murcury, Lead, Arsenic and cadmium. Soil pollution, Domestic and Commercial Garbage: solid waste managment. The Recycling of Household and Commercial Waste, Hazardous Wastes and methods of disposal

UNIT-IV **6**

Toxic Organic Compounds, Pesticides, Insecticides, Herbicides, Dioxins, Furans, and PCBs, Polynuclear Aromatic Hydrocarbons Chemistry of food additives, dyes, detergents and bleaching agents

**Books & References**


1. Environmental Chemistry - Colin Baird and Michael Cann, W. H. Freeman
2. Environmental Chemistry - Stanley E. Manahan, CRC Press; 9th edition.
3. Sonja Krause, Herbert M. Clark, James P. Ferris, Robert L. Strong Chemistry of the Environment,Elsevier Science & Technology Books.
4. Eugene R. Weiner Applications of Environmental Chemistry, CRC Press, LLC.
5. By Clair N.Sawyer,Perry L. McCarty, Gene F.Parkin Chemistry for environmental engineering and science (5th edition), McGraw-Hill Professional.


**BSM-156 Applied Probability and Statistics**

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

1. To understand the basic concepts of probability and probability Distributions.
2. To understand the central tendency, correlation, and correlation coefficient and also regression.
3. To understand the fitting of various curves by method of least square
4. To apply the statistics for testing the significance of the given large and small sample data by using t- test, F- test and Chi-square test.
5. Application of probability and statistics in real life.
6. To inculcate the habit of statistical thinking and lifelong learning.

**Topics Covered**

**UNIT-I** 9

**Basic Statistics:** Frequency distribution, Mean, Median, Mode, Moments, Moment Generating function, Skewness, Types of Skewness, Measurement of Skewness, Kurtosis, and its types. Curve fitting: Method of Least Squares, Fitting of Straight lines, Fitting of Parabola of second degree.

**UNIT-II** 9

**Applied Statistics:** Correlation, Correlation coefficient, Spearman's rank correlation coefficient, Regression, Equation of regression lines, linear, and non-linear regression analysis. Relation between Regression Analysis and Correlation Analysis

**UNIT-III** 9

**Probability:** Random experiment, outcome, trial and event, Exhaustive events, favourable events, independent events, sample space, classical and empirical definition of probability, addition theorem of probability, multiplication theorem of probability, conditional probability, Baye's theorem.

**UNIT-IV** 9

**Probability Distribution:** Discrete and continuous random variable and their properties, distribution functions, Binomial, Poisson and Normal Distribution and evaluation of statistical parameter of these three distributions. **Test of significance:** sampling, large sample test for single proportion, difference of proportions, single mean, difference of means and difference of standard deviation, Chi-square test for goodness of fit.

**Books & References**


1. D. C. Montgomery and G. C. Runger, Applied Statistics and Probability for Engineers, Wiley.
2. J. L. Devore, Probability and Statistics for Engineering and the Sciences, Cengage Learning.
3. S.M. Ross, Introduction to Probability and Statistics for Engineers and Scientists, Academic Press; 5th edition
4. Robert V Hogg, Joseph McKean, Allen T Craig, Introduction to Mathematical Statistics, Pearson Edu.
5. Mood, Graybill and Boes, Introduction to the Theory of Statistics, Tata McGraw-Hill.


**BCS -151** **Introduction to C Programming**

Course category: Engineering Fundamental (EF)

| | |
|---|---|
| Pre-requisite Subject: | NIL |
| Contact hours/week: | Lecture: 3, Tutorial: 1, Practical: 2 |
| Number of Credits: | 5 |
| Course Assessment methods: | Continuous Assessment through Two Tests, Teacher Assessment (Quiz, Tutorial, Assignment, Attendance), Practical Work & Viva-voce, and One Major Theory & One Practical Examinations. |

**Course Objective**: The course covers the basics of programming and demonstrates fundamental programming techniques, customs and terms including the most common library functions and the usage of the pre-processor.

1. To develop C Programs using basic programming constructs
2. To develop C programs using arrays and strings
3. To develop applications in C using functions and structures

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

1. Basic terminology used in computer programming.
2. Programs development in C Language by writing, compiling and debugging.
3. Design of programs involving simple statements, conditional statements, iterative statements, array, strings, functions, recursion, structure and union.
4. Dynamic memory allocations and use of pointers.
5. Basic operations on a file.
6. Basics of dynamic memory.

**UNIT-I** **9L**

**Basics of programming:** Approaches to Problem Solving, Concept of Algorithm and Flow Charts, Types of Computer Languages: Machine Language, Assembly Language and High-Level Language, Concept of Assembler, Compiler, Linker and Loader. Data types, Storage Classes: Auto, Extern, Register and Static. Operators, Expressions, Operator Precedence and Associativity. **Fundamentals of C Programming:** Structure of C Program, Writing and Executing the First C Program, Components of C Language, Standard I/O, Formatted I/O. Conditional Program Execution: Applying if and switch Statements, Nesting if and else. Program Loops and Iterations: Use of while, do while and for Loops, Multiple Loop Variables, Use of break and continue Statements, goto Statement.

**UNIT-II** **9L**

**Arrays:** One Dimensional, Multidimensional Array and Their Applications, Declaration and Manipulation of Arrays. **Strings:** String Variable, String Handling Functions, Array of Strings.
*Functions:* Designing Structured Programs, Functions in C, User Defined and Standard Functions, Formal vs. Actual Arguments, Function Category, Function Prototype, Parameter Passing, Recursive Functions.
Storage Classes revisited.

**UNIT-III** **9L**

**Pointers:** Pointer Variable and its Importance, Pointer Arithmetic Pointers and Arrays, Pointer and Character Strings, Pointers and Functions, Array of Pointers, Pointers to Pointers. **Structure:**

Declaration and Initialization of Structures, Structure as Function Parameters, Structure Pointers. **Union:** Declaration and Initialization of Unions, Union as Function Parameters, Union Pointers.

**UNIT-IV** **9L**

**Dynamic Memory Allocation:** malloc, calloc, realloc, free functions. **File Management:** Defining and Opening a File, Closing a File, Input/ Output Operations in Files. The Pre-processor Directives, Macros. Command Line Arguments. Introduction to Graphics Programming.

**EXPERIMENTS**

1. Write programs to print statements in sequential order using simple printf, scanf input/output functions.
2. Write programs to implement if-else condition (simple as well as nested) on suitable problems.
3. Write program to implement switch-case conditional logic on suitable examples.
4. Write programs to implement for, while and do-while loop control statements on suitable problems.
5. Write programs to implement 1D & 2D array concepts on suitable problems such as sorting of elements, searching of element, matrix addition, subtraction, multiplication etc.
6. Write programs to implement string related concepts such as sorting of a string, finding its length, reversing, concatenation, comparing two strings etc.
7. Write programs to implement concept of user defined functions (call by value, call by reference, recursive calling etc.) on suitable examples.
8. Write programs to implement concepts of pointer.
9. Write programs to implement the concept of structure and union.
10. Write programs to implement dynamic memory allocation functions (calloc, malloc, free, realloc)
11. Write programs to implement file handling concepts such as reading from a file, writing to a file using file related functions (fclose, fopen, sscanf, sprint, fread, fwrite, getc, putc, getw, putw etc.)

**Textbooks**


1. Jeri R. Hanly and Elliot B. Koffman, Problem Solving and Program Design in C, 7th Edition, Pearson.
2. Schildt, Herbert, Complete Reference with C, Tata McGraw Hill.
3. Kerninghan and Ritchie, The C programming Language, 2nd Edition, Prentice Hall.
4. Richard Bird, Introduction to Functional Programming using Haskell, 2nd Edition, Prentice-Hall International, 1998.


**Reference Books**


1. Greg Michaelson, An Introduction to Functional Programming Through Lambda Calculus, Dover Edition, Addition Wesley Publication.
2. Samuel P. Harbison, and Guy L. Steele Jr., C-A Reference Manual, Fifth Edition, Prentice Hall, 2002.


**BSM-**129/**179** **QUANTUM PHYSICS AND NANOMATERIALS**

**(for Computer Science and Engineering)**

| | | |
|---|---|---|
| **Course category** | : | Basic Sciences & Maths (BSM) |
| **Pre-requisite Subject** | : | Physics at $12^{th}$ standard |
| **Contact hours/week** | : | Lecture: 3, Tutorial: 1, Practical: 0 |
| **Number of Credits** | : | 4 |
| **Course Assessment methods** | : | Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce and Two Minor tests and One Major Theory. |
| **Course Objectives** | | Understanding of the principle and concepts of Solid State Physics, : :Electronics and Devices, Quantum Mechanics and Advanced Materials for their applications in Computer Science and Engineering. |
| **Course Outcomes** | : | The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course |

1. Basics of Band theory of solids and its application in Engineering
2. Basic Principles of Semiconductor and its application to understand semiconducting devices
3. Quantum Mechanics and its application to understand material properties at atomic level.
4. Basic principles of Electronics Devices
5. Basic Principles of advanced materials and their application in Engineering.
6. Basics of Nanomaterials and its application to nanoscience and technology.

**Topics Covered**

**UNIT-I**

**Solid State Physics**

Band theory of solids: Band theory of solids, Conductors, insulators and semiconductors, Thermal properties of Materials: Thermal properties of solids, Lattice vibration, specific heat, Debye theory, Einstein theory, Magnetic properties of Materials: Magnetism: Dia, para and ferro magnetism

**UNIT-II**

**Semiconductor Devices**

Intrinsic and extrinsic semiconductors, p-n junction, p-n-p and n-p-n transistors, Amplifiers, Oscillators, and Op-amps, FET and MOSFET, Digital Electronics: Boolean Algebra, Demorgan's laws, Logic gates and truth tables.

**UNIT-III**

**Quantum Mechanics**

Broglie waves and Group velocity concept, Uncertainty principle and its application, Davisson-Germer experiment, Stern Gerlach experiment, electron spin, Derivation of Schrodinger equation for

time independent and time dependent cases. Postulates of quantum mechanics, Significance of wave function, Application of Schrodinger wave equation for a free particle; Particle in a box (one dimensional)

**UNIT-IV**

**Physics of Advanced Materials**

Temperature dependence of resistivity in superconducting materials, Effect of magnetic field (Meissner effect), Type I and Type II superconductors, BCS theory (Qualitative), Nanomaterials: Introduction of nanoscience and technology

**Books & References**


1. Introduction to Solid State Physics- Kittel , 7th edition, Wiley Eastern Ltd.
2. Solid State Physics - S. O. Pillai, 5th edition, New Age International.
3. Quantum Physics by H. C. Verma, 3rd Edition, Surya Publication Ghaziabad,
4. Introduction to Electrodynamics- David J. Griffiths Pearson, New International Edition
5. Semiconductor Devices and Application - S.M. Sze, Wiley
6. Introduction to Nano Technology - Poole Owens, Wiley India
7. Master Hand book of Acoustics - F. Alton Everest and Ken Pohlmann, 5th edition, McGraw Hill
8. Engineering Physics by B. K. Pandey and S. Chaturvedi, 2e Cengage Learning Pvt. Limited, India.


| **BCS-152** | **Web Designing-2** |
|---|---|
| Course category: | Professional Skill (PF) |
| Pre-requisite Subject: | NIL |
| Contact hours/week: | Lecture: 1, Tutorial: 0, Practical: 2 |
| Number of Credits: | 2 |
| Course Assessment methods: | Continuous Assessment through Two Tests, Teacher Assessment (Quiz, Tutorial, Assignment, Attendance), Practical Work & Viva-voce, and One Major Theory & One Practical Examinations. |

**Course Objective:** The Advanced Web Design course is designed to prepare students for professional web design work. The class will be a mix of theoretical/soft skills and more practical front-end techniques. The objective will be

1. To design web sites which use HTML tables, forms, frames, and Cascading Style Sheets.
2. To learn the advantages of HTML tables, forms, frames Cascading Style Sheets and CSS box model and when they are best utilized.
3. To provide definitions and explanations for a large number of technical terms and acronyms related to web site design.
4. To apply the techniques and features of imagemaps to web site navigation.
5. To understand the issues related to web graphics (size versus resolution) as well as how to create, optimize, and display graphic images.
6. Be able to create and edit simple animated web graphics.

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

1. Understand principle of Web application design.
2. Understand principle of Application Programming Interface (API).
3. Apply the knowledge of Node JS on web application development.
4. Host the web application on web server.
5. learn how to employ meta tags and HTML cookies to improve the experience of web site visitors.
6. be able to create, validate, transform and display XML files.

**UNIT-I** **3L**

Introduction to Node JS, Setup Dev Environment, Node JS Modules, Node Package Manager.

**UNIT-II** **3L**

Creating Web server, File System, Debugging Node JS Application, Events, Express.JS, Serving Static Resources.

**UNIT-III** **3L**

Basics of MySQL, Query building, Database connectivity using Node JS

**UNIT-IV** **3L**

Introduction to Nginx server, Introduction to AWS EC2, Web application hosting on AWS.

**EXPERIMENTS**

1. Create API to authentication using Node JS.
2. Create API for session management in Node JS.
3. Create a web application to search an employee from an employee database.
4. Create a web application to generate salary receipt of an employee of an organization.
5. Create a web application for leave management of employees of an organization.
6. Host the employee web application on AWS EC2 server.

**Textbooks**:

1. Ethan Brown, Web Development with Node and Express: Leveraging the JavaScript Stack, O'Reilly Media, Inc.
2. David Stokes, MySQL and JSON: A Practical Programming Guide, Oracle Press.

**BCS-153** **IT Tools and Workshop-1**

| | |
|---|---|
| Course category: | Engineering Fundamental (EF) |
| Pre-requisite Subject: | NIL |
| Contact hours/week: | Lecture: 0, Tutorial: 0, Practical: 4 |
| Number of Credits: | 2 |

| | |
|---|---|
| Course Assessment methods: | Continuous Assessment through Teacher Assessment (Quiz, Tutorial, Assignment, Attendance), Practical Work & Viva-voce, and One Practical Examinations. |

**Course Objective:** The IT tools and Workshop-I is a training lab course to get training on PC Hardware, Internet & World Wide Web, and Productivity tools for documentation, Spreadsheet computations, and Presentation. It is

1. To introduce to a personal computer and its basic peripherals, the process of assembling a personal computer, installation of system software like MS Windows, Linux and the required device drivers, hardware, and software.
2. Install, configure Operating Systems and device drivers.

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

1. Understand basics knowledge of report and presentation software's.
2. Understand the basic knowledge of Excel.
3. Understand the basic knowledge of photo and video editing tools.
4. Understand the basic knowledge of tools supporting program writing and management.
5. Apply the tools for preparation of PPT, Documentation and budget sheet etc.
6. Apply knowledge for computer assembling and software installation.

**EXPERIMENTS**

The students will perform following experiments to get familiar with Computer.

1. Introduction to all the features of Microsoft Word and preparation of a report based on observed features.
2. Introduction to all features of Microsoft PowerPoint and preparation of a presentation based on observed features.
3. Introduction to all features of Microsoft Excel for data analysis and management using macros. Perform analysis of student database of university.
4. Introduction to all features of Adobe Photoshop for photograph editing and editing various photographs of university departments.
5. Introduction to all features of Adobe Premiere Pro for video editing creating a campus tour of university.
6. Working on Linux operating system and its various commands.
7. Introduction to Visual Studio Code for programs writing.
8. Introduction to Git for source code management.
9. Creating an animated video using latest open-source software

| | |
|---|---|
| **Subject Code: (BEC-154)** | **Basic Electronic Components and Circuits** |
| Course category | : Engineering Fundamentals (PLBSE) |
| 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, viva voce and minor and major theory Examination

**Course Assessment methods** : Continuous assessment through attendance, home assignments, quizzes, practical work, record, viva voce and 2-Minor tests and One Major Theory & Practical Examination

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

1. Able to memorize the basic concept of electronic circuits using Diode, BJT, FET, etc.
2. Able to execute and examine the general characteristic of electronic circuits.
3. Illustrate the basics of Boolean algebra and logic gates with their realisation using discrete electronic components.
4. Compute different parameters for characterising different circuits like rectifier, amplifiers, integrators, etc.
5. Examine the working principle of digital voltmeter, millimeter using block diagram approach.
6. Discuss and calculate voltage, current, phase and frequency using CRO.

**Topics Covered**

**UNIT-I**

Semiconductor materials and properties: electron-hole concepts, Basic concepts of energy bands in materials, concept of forbidden gap, Intrinsic and extrinsic semiconductors, donors and acceptors impurities, Junction diode, p-n junction, depletion layer, v-i characteristics, diode resistance, capacitance, diode ratings (average current, repetitive peak current, non-repetitive current, peak-inverse voltage). Diode Applications in rectifier, filters, voltage multipliers, load regulators, clipper and clamper circuits, Breakdown mechanism (Zener and avalanche),Breakdown characteristics, Zener resistance, Zener diode ratings, Zener diode application as shunt regulator 9

**UNIT-II**

Transistors(BJT and FET);Basic construction, transistor action, CB, CE and CC configurations, input/output characteristics, Biasing of transistors-fixed bias, emitter bias, potential divider bias, comparison of biasing circuits. Transistor Amplifier: Graphical analysis of CE amplifier, concept of voltage gain, current gain, h- parameter model (low frequency), computation of Ai, Av, Ri, Ro of single transistor CE and CC amplifier configurations. 9

**UNIT-III**

**JFET & MOSFET/ Switching theory and logic design**: 9

Field Effect Transistors(JFET and MOSFET): Basic construction, transistor action, concept of pinch off, maximum drain saturation current, input and transfer characteristics, characteristic equation CG, CS and CD configurations, fixed & self-biasing. application of

MOSFET as an amplifier and switch

Number systems, conversion of bases, Boolean algebra, logic gates, concept of universal gate, canonical forms, Minimization using K-map

**UNIT-IV**

**Operational Amplifier:** Concept of ideal operational amplifiers, ideal op-amp parameters, inverting, non-inverting and unity gain amplifiers, adders, difference amplifiers, integrators, Other Circuits based on Operational Amplifiers 9

**EXPERIMENTS**

**Note: Minimum Five experiments are to be performed**

1. To plot the forward / Reverse Characteristics of Si P-N junction diode.
2. To plot the forward / Reverse Characteristics of Zener diode
3. Study and plot the characteristic of Zener diode as voltage regulator
4. Study of half wave rectifier and draw the nature of input / output signal. Calculate the value of $I_{dc}$, $I_{rms}$ and ripple factor.
5. Study of Full wave rectifier and draw the nature of input / output signal. Calculate the value of $I_{dc}$, $I_{rms}$ and ripple factor.
6. Study of Bridge Rectifier and draw the nature of input / output signal. Calculate the value of $I_{dc}$, $I_{rms}$ and ripple factor.
7. Draw input output characteristic curve of n-p-n transistor in CE configuration
8. Draw input output characteristic curve of n-p-n transistor in CB configuration
9. Draw the drain and transfer curve of JFET
10. Study of OPAMP (741) and calculate the gain in (i)Inverting mode and (ii)Non-inverting mode
11. Study of OP-AMP as a (i) Summer (ii) Integrator (iii) Differentiator; and plot the nature of input & output waveform
12. Study of CRO and multi-meter measurement voltage, frequency, phase difference using CRO along with the testing of electronics component

**Books & References**


1. Electronic Devices and Circuits-Boylestad and Nashelsky, 6e, PHI, 2001
2. Electronic Devices and Circuits, A Mottershead, PHI,2000, 6e
3. Digital Computer Design, Morris Mano, PHI,2003
4. Electronic Instrumentation-H.S. Kalsi, 2e,TMH, 2007


**BSM-202 Discrete Mathematics**

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

1. Use of logical notation to define different function such as set, function and relation.
2. Use of basic properties of group theory in computer science.
3. Use of induction hypotheses to prove formulae.
4. To know the basic techniques in combinatorics and counting.
5. Identify and apply properties of combinatorial structures.
6. To inculcate the habit of mathematical thinking and lifelong learning.

**Topics Covered**

**UNIT-I** 9

**Set Theory, Relation and Function:** Operations on sets, relations and functions, binary relations, partial ordering relations, equivalence relations, principles of mathematical induction. Finite and infinite sets, countable and uncountable sets, Cantor's diagonal argument and the power set theorem, Schröder-Bernstein theorem.

**UNIT-II** 9

**Propositional logic:** Syntax, semantics, valid, satisfiable and unsatisfiable formulas, encoding and examining the validity of some logical arguments.

**Proof techniques:** Forward proof, proof by contradiction, contrapositive proofs, proof of necessity and sufficiency.

**UNIT-III** 9

**Algebraic Structures:** Algebraic structures with one binary operation - semigroups, monoids and groups, congruence relation and quotient structures. Free and cyclic monoids and groups, permutation groups, substructures, normal subgroups. Algebraic structures with two binary operations - rings, integral domains and fields. Boolean algebra and Boolean ring.

**UNIT-IV** 9

**Combinatorics:** Basic counting techniques: inclusion and exclusion, pigeon-hole principle, permutation, combination, summations. Introduction to recurrence relations and generating functions.

**Books & References**


1. Kenneth H Rosen, Discrete Mathematics and its Applications, TMH.
2. C L Liu, Elements of Discrete Mathematics, Second Edition, Tata McGraw-Hill.
3. Bernard Kolman, Robert C Busby, and Sharon Cutler Ross, Discrete Mathematical Structures, fifth edition, Prentice-Hall of India.
4. Ralph P Grimaldi, Discrete and Combinatorial Mathematics, Pearson Education Asia.
5. J P Tremblay and R Manohar, Discrete Mathematical Structures with Applications to Computer Science, Tata McGraw-Hill.


**BCS-201 Digital Circuits and Logic Design**

**Course Category:** PC

**Pre-requisite Subject:** NIL

**Contact Hours/Week:** Lecture: 3, Tutorial: 0 & Practical: 2

**Number of Credits:** 4

**Course Assessment Method:** Continuous Assessment through Two Tests, Teacher Assessment (Quiz, Tutorial, Assignment, Attendance), Practical Work & Viva-voce, and One Major Theory & One Practical Examinations.

**Course Objective:** This course helps the students in gaining the knowledge of basic principles of digital circuit design and different number systems. This course helps in building a solid foundation to undertake future courses such as computer organization and architecture.

1. Discuss basic building blocks of logic design
2. Learn how circuits are designed in a real computer system
3. Introduce different number systems
4. Learn current trends in circuit design
5. Be familiar with issues and trade-offs in the design of digital circuits

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

1. Design a finite state machine and sequential logic design.
2. Synthesize a logic design from a natural language description of a problem.
3. Realize a complete arithmetic and logic unit.
4. Generate a realization of combinational logic in a programmable gate array.
5. Simulate a complete design to evaluate functional correctness and timing.
6. Conduct an experiment to learn the logic design and prototyping process in order to acquire requisite hands-on skills

**Topic Covered**

**UNIT-I** **9L**

Binary Codes - Weighted and Non-Weighted - Binary Arithmetic Conversion Algorithms - Error Detecting and Error Correcting Codes - Canonical and Standard Boolean Expressions - Truth Tables.

**UNIT-II** **9L**

K-Map Reduction - Don't Care Conditions - Adders / Subtractors- Carry Look-Ahead Adder - Code Conversion Algorithms - Design of Code Converters - Equivalence Functions.

Binary/Decimal Parallel Adder/Subtractor for Signed Numbers - Magnitude Comparator - Decoders / Encoders - Multiplexers / Demultiplexers- Boolean Function Implementation using Multiplexers.

**UNIT-III** **9L**

Sequential Logic - Basic Latch - Flip-Flops (SR, D, JK, T and Master-Slave) - Triggering of Flip-Flops - Counters - Design Procedure - Ripple Counters - BCD and Binary - Synchronous Counters.

**UNIT-IV** **9L**

Registers - Shift Registers - Registers with Parallel Load - Memory Unit - Examples of RAM, ROM, PROM, EPROM - Reduction of State and Flow Tables - Race-Free State Assignment - Hazards.

**Textbooks**

1.Morris Mano, Digital Design, Prentice Hall of India, 2001

2.Raj Kamal, Digital Systems Principles and Design, Pearson Education, FirstEdition, 2007

3.Charles H.Roth, Jr. and Larry L. Kinney, Fundamentals of Logic Design, CL Engineering, Seventh Edition, 2013.

**Reference books**

1.W. H. Gothmann, Digital Electronics -An Introduction to Theory and Practice, Prentice Hall of India, 2000

2.Donald D.Givone, Digital Principles and Design, Tata McGraw –Hill, Thirteenth Impression, 2003.

**BHM-202 CYBER ETHICS AND IPR (L-T-P: 2-0-0)**

**Course Category**: Humanities & Social Science Elective (HSSE)
**Pre-requisite Subject**: None
**Contact hours/week**: 2 hours per week
**No of Credits**: Lecture: 2, Tutorial:0, Practical: 0 (Total Credit: 02)
**Course Assessment Methods**: Continuous assessment through tutorials, attendance, home assignments, quizzes and one minor test, one major theory.

**Course Objective**: The Course aims:
1.Sensitize course participants on ethical aspects in a broad variety of current topics of the cyber society.
2. Offer core values and virtues and methods for values-driven decisions in cyber space.
3. Empower course participants to apply values and virtues to fast developing new challenges and opportunities in cyber space.

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

1. Recognize the main ethical aspects in cyber environment.
2. Apply ethics, core values to all decisions that are made within cyber space.
3. Analyze cyber space management approaches and models from the ethical perspective
4. To understand the cyber ethics and the laws under cyber space
5. To recognize the media laws applicable for media content and production
6. To understand the freedom of media and rights under our constitution

**UNIT-I**

Information Technology Act, 2000 - Aims and Objects - Overview of the Act – Jurisdiction - Electronic Governance – Electronic Evidence

Introduction to Cyber Laws: Cyber Law – National and International Perspective Cyber Law - Legal Issues and Challenges in India, Cybercrime Definition, cybercrime and information security, cybercrimes with mobile and wireless devices.

**UNIT-II**

Cyber Ethics, Significance of cyber-Ethics, Need for Cyber regulations and Ethics. Ethics in Information society, Introduction to Artificial Intelligence Ethics: Ethical Issues in AI and core Principles, Introduction to Block chain Ethics.

**UNIT-III**

Intellectual Property Rights: Definition, objectives & scope, Cyber Law and IPRs
Copyright: Definition, objectives, scope, benefits, Main Provisions of Copyright Act, Issues in Cyberspace.

**UNIT-IV**

Indian Patent Act, definition, objectives, types, Copyrights Vs Patent
Trademarks – introduction, benefits for business, Trademarks in Internet - Domain name registration, Trademarks in Internet

**Suggested Readings**


1. Stückelberger C. & Duggal P. (2018) Cyber Ethics 4.0: Serving Humanity with Values. Geneva, Globethics.net, ISBN: 978-2-88931-264-1 (online version), ISBN: 978-2-88931-265-8 (print version).
2. D.P. Mittal (Taxman Publication), Indian Patents Law and Procedure
3. B.L. Wadera, Patents, trademarks, copyright, Designs and Geographical Judications.
4. P. Narayanan (Eastern Law House), Intellectual Property Law.
5. N.S. Gopalakrishnan & T.G. Agitha, Principles of Intellectual Property (2009), Eastern Book Company, Lucknow.


| **BCS-202** | **PRINCIPLES OF DATA STRUCTURES** |
|---|---|
| **Course Category** | Department Core (DC) |
| **Pre-requisite Subject** | NIL |
| **Contact Hours/Week** | Lecture: 3, Tutorial: 1 & Practical: 2 |
| **Number of Credits** | 5 |
| **Course Assessment Methods** | Continuous Assessment through Two Tests, Teacher Assessment (Quiz, Tutorial, Assignment, Attendance), Practical Work & Viva-voce, and One Major Theory & One Practical Examinations. |

**Course Objective:** This course helps the students in gaining the knowledge of basic principles of Data Structures. The principal objectives of this course are:

1. To provide the knowledge of basic data structures and their implementations.
2. To understand importance of data structures in context of writing efficient programs.
3. To develop skills to apply appropriate data structures in problem solving.

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

1. Learn the basic types for data structure, implementation, and application.
2. Know the strength and weakness of different data structures.
3. Use the appropriate data structure in context of solution of given problem.
4. Develop programming skills which require to solve given problem.
5. Apply Algorithm for solving problems like sorting, searching, insertion and deletion of data
6. Solve problem involving graphs, trees and heaps.

**Topics Covered**

**UNIT-I** **9L**

**Introduction:** Basic Terminology, Elementary Data Organization, Structure Operations, Complexity and Time-Space Trade-off.

**Arrays**: Definition, Representation and Analysis, Single and Multi-Dimension Array, Address Calculation, Application of Arrays, Character, String in C, Character String Operation, Arrays Parameters, Ordered List, Sparse Matrices and Vectors

**Stacks:** Array Representation and Implementation of Stack, Operations on Stacks: Push &Pop, Array Representation of Stack, Linked Representation of Stack, Operations Associated with Stacks, Application of Stack, Conversion of Infix to Prefix and Postfix Expressions, Evaluation of Postfix Expressions using Stack, Application of Recursion in Problem like Tower of Hanoi.

**UNIT-II** **9L**

**Queues:** Array and Linked Representation and Implementation of Queues, Operations on Queue: Create, Add, Delete, Full and Empty, Circular Queues, D-Queues and Priority Queues.

**Linked List:** Representation and Implementation of Singly Linked Lists, Two-Way Header List, Traversing and Searching of Linked List, Overflow and Underflow, Insertion and Deletion to / from Linked Lists, Insertion and Deletion Algorithms, Doubly Linked List, Linked List in Array, Polynomial Representation and Addition, Generalized Linked List, Garbage Collection and Compaction.

**UNIT-III** **9L**

**Trees:** Basic Terminology, Binary Trees, Binary Tree Representation, Algebraic Expressions, Complete Binary Tree, Extended Binary Trees, Array and Linked Representation of Binary Trees, Traversing Binary Trees, Threaded Binary Trees, Traversing Threaded Binary Trees, Huffman Algorithm.

**Binary Search Trees:** Binary Search Tree (BST), Insertion and Deletion in BST, Complexity of Search Algorithm, Path Length, AVL Trees, B-Trees.

**UNIT-IV** **9L**

**Searching and Hashing:** Sequential Search, Binary Search, Comparison and Analysis, Hash Table, Hash Functions, Collision Resolution Strategies, Hash Table Implementation.

**Sorting:** Insertion Sort, Bubble Sorting, Quick Sort, Two Way Merge Sort, Heap Sort, Sorting on Different Keys, Practical Consideration for Internal Sorting.

**Graphs:** Terminology & Representations, Graphs &Multi-Graphs, Directed Graphs, Sequential Representations of Graphs, Adjacency Matrices, Traversal, Connected Component and Spanning Trees, Minimum Cost Spanning Trees.

**EXPERIMENTS**

Write C/C++ Programs to illustrate the concept of the following:

1. Implementation of searching and sorting techniques.
2. Implementation of list using array and linked list.
3. Implementation of push and pop operation on stack
4. Implementation of polish notation and its conversion
5. Write a program to solve the problems using iteration/recursion
6. Program for recursion removal using stack
7. Program for insertion /deletion operation on various queue & Implementation of priority queue for process scheduling
8. Program for storing data as tree structure and implementation of various traversal techniques
9. Program for storing data as graph structure and implementation of various traversal techniques
10. Program for finding shortest path in graph

**TEXTBOOKS**


1. Horowitz and Sahani, Fundamentals of Data Structures, Galgotia Publication, New Delhi.
2. R. Kruse et al, Data Structure and Pragram Design in C, Pearson Education Asia Delhi
3. A. M. Tenenbaum, Data Structures using C & C++, PHI, India
4. K Loudon, Mastering Algorithms with C, Shroff Publication and Distributor Pvt. Ltd.
5. Bruno R Preiss, Data Structure and Algorithms with Object Oriented Design Pattern in C++, John Wiley & Sons
6. Adam Drozdek, "Data Structures and Algorithms in C++", Thomson Asia Pvt. Ltd. Singapore


**REFERENCE BOOKS**


1. Lewis, H.R., Denenberg, L., Data Structures and their Algorithms. Published by AddisonWesley, UK, 1991
2. Oluwadare, S.A., Agbonifo, O.C., Fundamentals of Data structures and Algorithms. Lecture Notes, 2013


**BCS-203 OBJECT ORIENTED PROGRAMMING**

| | |
|---|---|
| **Course Category** | PC |
| **Pre-requisite Subject** | NIL |
| **Contact Hours/Week** | Lecture: 3, Tutorial: 1 & Practical: 2 |

| | |
|---|---|
| **Number of Credits** | 5 |
| **Course Assessment Methods** | Continuous Assessment through Two Tests, Teacher Assessment (Quiz, Tutorial, Assignment, Attendance), Practical Work & Viva-voce, and One Major Theory & One Practical Examinations. |

**Course Objective:** This course helps the students in gaining the knowledge of basic principle of design and analysis of algorithms. This course helps to undertake future courses that assume as a background in data structures and algorithm design.

1. To introduce the object-oriented programming concepts.
2. To understand object-oriented programming concepts and apply them in solving problems.
3. To introduce the principles of inheritance and polymorphism; and demonstrate how they relate to the design of abstract classes.
4. To introduce the implementation of packages and interfaces.
5. To introduce the concepts of exception handling and multithreading.
6. To introduce the design of Graphical User Interface using applets and swing controls.

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

1. Able to implement, compile, test and run JAVA programs comprising more than one class and to address a particular software problem.
2. Able to solve real world problems using OOP techniques.
3. To identify different components of client server architecture on Internet computing.
4. Knowledge of how to develop and deploy applications and applets in JAVA.
5. Knowledge of how to develop and deploy GUI using JAVA Swing and AWT.
6. Design, develop and implement interactive web applications.

**TOPIC COVERED**

**UNIT-I** **9L**

Introduction to the principles of object-oriented programming, Core Java: Introduction, Operator, Data types, Variables, Control Statements, Arrays, Methods & Classes, Constructors, String Handling, Inheritance, Package and Interface.

**UNIT-II** **9L**

Exception Handling, Multithread programming, I/O, Java Applet, Networking, Event handling, Introduction to AWT, AWT controls, Layout managers.

**UNIT-III** **9L**

Java Swing: Creating a Swing Applet, Labels, Text fields, Buttons, Tabbed Panes, JDBC: Connectivity Model, JDBC/ODBC Bridge, JAVA SQL package, connectivity to Remote Database, Remote method invocation (RMI).

**UNIT-IV** **9L**

Java Beans: Application Builder tools, The Bean Developer Kit (BDK), JAR files, Introspection, developing a simple bean, using Bound properties, The Java Beans API, Session Beans, Entity Beans, Introduction to Java Servlet: Servlet Basics, Servlet API basic, Life cycle of a Servlet, Running Servlet.

**EXPERIMENTS**

1. Basic programs of simple statements, conditional statements, iterative statement, and arrays.
2. Programs having object-oriented concepts like Inheritance and Interface.
3. Programs for Exception Handling and Event Handling.
4. Programs of Threads and Multithreading.
5. Programs related to Applets and Swings.
6. Program including JAVA Beans and Servlets.

**TEXTBOOKS**


1. Herbert Schildt, Java The Complete Reference, 9th edition, McGraw Hill Education (India) Pvt. Ltd.
2. T. Budd, Understanding Object-Oriented Programming with Java, Pearson Education
3. Balagurusamy E, "Programming in JAVA", TMH


**REFERENCE BOOK**


1. Deitel & Deitel, JAVA: How to Program, Pearson education
2. Margaret Levine Young, "The Complete Reference Internet", TMH.
3. Dustin R. Callway, "Inside Servlets", Addison Wesley.
4. Mark Wutica, "Java Enterprise Edition", QUE.
5. Steven Holzner, "Java2 Black book", Dreamtech.


**BCS-204 IT Tools and Workshop-2**

| | |
|---|---|
| **Course Category** | PLBSE |
| **Pre-requisite Subject** | NIL |
| **Contact Hours/Week** | Lecture: 0, Tutorial: 0 & Practical: 4 |
| **Number of Credits** | 2 |
| **Course Assessment Methods** | Continuous Assessment through Teacher Assessment (Quiz, Tutorial, Assignment, Attendance), Practical Work & Viva-voce, and One Practical Examinations. |

**Course Objective:** This course helps the students in gaining the knowledge of basic tools/library being used in IT industry. The course objectives of above course are-

1. To understand the installation and various commands of Linux Operating System.
2. To understand the Shell programming and Computer Networking Concepts.
3. To understand basics of python and its important modules.

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

1. Understanding of Booting Process and Installation of Linux Operating System.

2. Demonstrate the usage of Shell as a programming language.
3. Understanding of Computer Networking concepts in Linux.
4. Basic knowledge of Python programming language.
5. Basic knowledge of various python libraries like xlrd, pandas, numpy, sklearn etc,
6. Understand the basic concept and structure of computer hardware and networking

**EXPERIMENTS**

1. Installation of Linux operating system using virtualization technique.
2. Understanding and practice of various Linux commands.
3. Write a shell script that receives any number of file names as arguments checks if every argument supplied is a file or a directory and reports accordingly. Whenever the argument is a file, the number of lines on it is also reported.
4. Illustrate by writing script that will print, message "Hello World, in Bold and Blink effect, and in different colors like red, brown etc using echo commands?
5. Write a shell script that accepts a file name, starting and ending line numbers as arguments and displays all the lines between the given line numbers.
6. Illustrate by writing script using for loop to print the pyramid patterns?
7. Write a shell script that accepts a list of file names as its arguments, counts and reports the occurrence of each word that is present in the first argument file on other argument files.
8. Understanding and practice of Computer networking commands.
9. Write a python script to find factorial of a given number.
10. Write a python script to find factorial of a given number.
11. Write a Python program to count the occurrences of each word in a given string sentence.
12. Python program to create a dictionary with key as first character and value as words starting with that character.
13. Write a python program to create, append and remove lists in python.
14. Write a program to demonstrate working with tuples in python.
15. Write a python program to read excel file from xlrd module and perform processing on that file.
16. Write a program to demonstrate working with pandas module in python.
17. Write a program to demonstrate working with numpy module in python.
18. Write a program to demonstrate working with sklearn module in python.

**TEXTBOOKS**


1. Richard Petersen, "Linux: The Complete Reference", Sixth Edition, McGraw Hill Education.
2. E. Balaguruswamy, "Introduction to Computing and Problem Solving Using Python", McGraw Hill Education India


**REFERENCE BOOK**


1. Richard Blum, "Linux Command Line and Shell Scripting Bible", 4th Edition, Wiley.

2. Paul Deitel and Harvey Deitel, "Python for Programmers", Pearson Education, 1st Edition, 2021.
3. John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data", Third Edition, MIT Press, 2021.

**BSM-253 Optimization Techniques**

**Course category** : Basic Sciences & Maths (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 Two Minor Tests and One Major Theory & Practical Examination.
**Course Objectives** The objective of this course is to introduce basic methods and algorithms of mathematical optimization and able to apply them to practical optimization problems in a computer science.
**Course Outcomes** : The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. To solve L.P.P. with various methods.
2. To solve L.P.P. by interior method.
3. To solve N.L.P.P. by various methods.
4. To solve GPP by various methods.
5. To solve the transportation and assignment problems
6. To apply the analytical and numerical techniques of optimization theory to engineering problems.

**Topics Covered**

**UNIT-I** 9

**Classical Optimization Techniques:** Single variable optimization, Multi - variables with and without constraints. Non-linear programming: Fibonacci method, Golden Section method. Quadratic Programming.

**UNIT-II** 9

**Linear Programming: Constrained Optimization Techniques:** Graphical Methods**,** Simplex method, Big-M Method, Two-Phase Method, Revised Simplex method, Karmarkar's method, Duality Theorems, Dual Simplex method, Decomposition principle.

**UNIT-III** 9

**Non-Linear Programming: Unconstrained Optimization Techniques:** Direct search methods: Random jumping method, Univariate method, Rosenbrock's method. Indirect search methods: Steepest Descent method, Cauchy-Newton Methods, Newton's method, Transportation problems, Assignment problems.

**UNIT-IV** 9

**Geometric Programming:** Polynomial, Unconstrained minimization problem, Degree of difficulty. Solution of an unconstrained **Geometric** Programming problem. Constrained minimization complementary Geometric Programming, Application of Geometric Programming, Deterministic Dynamic Programming.

**Experiments**

1. To implement Fibonacci method to find optimal value.
2. To implement Golden Section method to find optimal value.
3. To implement Simplex Method to solve LPP.
4. To implement Revised Simplex Method to solve LPP.
5. To implement Dual Simplex method to solve LPP.
6. To implement Karmarkar's method to find the optimal value.
7. To implement Transportation problems by various methods.

**Books & References**


1. S.S. Rao; Engineering Optimization, New Age International.
2. E.J. Haug and J.S. Arora; Applied Optimal Design, Wiley New York.
3. Kalyanmoy Deb; Optimization for Engineering Design, Prentice Hall of India.
4. Er. P. K. Gupta; Operations Research, S. Chand.
5. G. Srinivasan, Operations Research, PHI Learning.


**BCS-251 Database Management Systems**

| | |
|---|---|
| **Course Category** | PC |
| **Pre-requisite Subject** | 1. Data Structures 2. Computer Programming Language |
| **Contact Hours/Week** | Lecture: 3, Tutorial: 0 & Practical: 2 |
| **Number of Credits** | 4 |
| **Course Assessment Methods** | Continuous Assessment through Two Tests, Teacher Assessment (Quiz, Tutorial, Assignment, Attendance), Practical Work & Viva-voce, and One Major Theory & One Practical Examinations. |

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**Course Objective:** This course helps the students in gaining the knowledge of basic principle of Database Management Systems and to undertake future courses that assume as a background in Database Management Systems.

1. Discuss basic theory and practice of database management systems
2. Design and implement new databases
3. Become familiar with fundamentals of database management systems and with the way these can best be implemented
4. Become accustomed to the description of database management systems in both functional and procedural styles

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

1. Define the basic concepts of database management systems.
2. Discuss various database design techniques for developing database systems.
3. Discuss various techniques for having control over concurrent database transactions.
4. Discuss various advanced topics on database management systems
5. Understand various transaction processing, concurrency control mechanisms and database protection mechanisms.
6. Demonstrate an understanding of normalization theory and apply such knowledge to the normalization of a database.

**TOPIC COVERED**

**UNIT-I** **9L**

**Introduction:** An Overview of Database Management System, Database System vs File System, Database System Concept and Architecture, Data Model Schema and Instances, Data Independence and Database Language and Interfaces, Data Definitions Language, DML, Overall Database Structure.

**Data Modeling using Entity Relationship Model:** ER Model Concepts, Notation for ER Diagram, Mapping Constraints, Keys, Concepts of Super Key, Candidate Key, Primary Key, Generalization, Aggregation, Reduction of An ER Diagrams to Tables, Extended ER Model, Relationship of Higher Degree.

**UNIT-II** **9L**

**Relational Data Model and Language:** Relational Data Model Concepts, Integrity Constraints, Entity Integrity, Referential Integrity, Keys Constraints, Domain Constraints, Relational Algebra, Relational Calculus, Tuple and Domain Calculus.

**Introduction on SQL:** Characteristics of SQL, Advantage of SQL. SQL Data Type and Literals. Types of SQL Commands. SQL Operators and their Procedure. Tables, Views and Indexes. Queries and Sub Queries. Aggregate Functions. Insert, Update and Delete Operations, Joins, Unions, Intersection, Minus, Cursors, Triggers, Procedures in SQL/PL SQL

**UNIT-III** **9L**

**Database Design &Normalization:** Functional Dependencies, Normal Forms, First, Second, Third Normal Forms, BCNF, Inclusion Dependence, Loss Less Join Decompositions, Normalization using FD, MVD, and JDS, Alternative Approaches to Database Design.

**UNIT-IV** **9L**

**Transaction Processing Concept:** Transaction System, Testing of Serializability, Serializability of Schedules, Conflict & View Serializable Schedule, Recoverability, Recovery from Transaction Failures, Log Based Recovery, Checkpoints, Deadlock Handling.

**Distributed Database:** Distributed Data Storage, Concurrency Control, Directory System.

**Concurrency Control Techniques:** Concurrency Control, Locking Techniques for Concurrency Control, Time Stamping Protocols for Concurrency Control, Validation Based Protocol, Multiple Granularity, Multi Version Schemes, Recovery with Concurrent Transaction, Case Study of Oracle.

**EXPERIMENTS**

1. Exercises to be based on Sybase / Oracle / Postgres / VB / Power Builder / DB2 / MS-Access.
2. Applications involving vendor development systems, stores management system, finance management etc.
3. Creation and querying of database tables for following cases.
   a. Write SQL queries using logical operations (=, etc)

b. Write SQL queries using SQL operators
c. Write SQL query using character, number, date and group functions
d. Write SQL queries for relational algebra
e. Write SQL queries for extracting data from more than one table
f. Write SQL queries for sub queries, nested queries
g. Write program using PL/SQL
h. Concepts for ROLL BACK, COMMIT & CHECK POINTS
i. Create VIEWS, CURSORS and TRGGERS & write ASSERTIONS.
j. Create FORMS and REPORTS

4. Design of tables by normalization and dependency analysis
5. Writing application software with host language interface

**TEXTBOOKS**

1. Date C J, An Introduction to Database Systems, Addison Wesley
2. Korth, Silbertz, Sudarshan, Database Concepts, McGraw Hill
3. Elmasri, Navathe, Fundamentals of Database Systems, Addison Wesley
4. O"Neil, Databases, Elsevier Pub.
5. Leon& Leon, Database Management Systems, Vikas Publishing House
6. Bipin C. Desai, An Introduction to Database Systems, Galgotia Publications
7. Majumdar & Bhattacharya, Database Management System, TMH
8. Ramkrishnan, Gehrke, Database Management System, McGraw Hill
9. Kroenke, Database Processing Fundamentals, Design and Implementation, Pearson Education.
10. J. D. Ulman, Principles of Database and Knowledge base System, Computer Science Press.
11. Maheshwari Jain. DBMS: Complete Practical Approach, Firewall Media, New Delhi

**REFERENCE BOOK**

1. Ramon a. Mato-Toledo, Pauline K. Cushman, Database Management Systems, Schaums Outline series, TMH, New Delhi Special Indian Edition 2007

2. Ivan Bayross, Mastering Database Technologies, BPB Publications, New Delhi - First Indian Edition 2006, Reprinted 2011

**BCS-252 THEORY OF COMPUTATION**

**Course Category :** PC

**Pre-requisite Subject :** NIL

**Contact Hours/Week :** Lecture: 3, Tutorial: 1 & Practical: 0

**Number of Credits :** 4

**Course Assessment Method:** Continuous Assessment through Two Tests, Teacher Assessment (Quiz, Tutorial, Assignment, Attendance), and One Major Theory Examination.

**Course Objective:** This course helps the students in gaining the knowledge of basic concept of machines: finite automata, pushdown automata, linear bounded automata, and Turing machines.

1. Discuss basic theory and applications of finite automata
2. Learn how the concepts introduced in this course are applicable in the design of efficient algorithms
3. Introduce Turing machines as a general model of computation
4. Learn the limits of computation

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

1. Analyse and design finite automata, pushdown automata, Turing machines, formal languages, and grammars.

2. Demonstrate the understanding of key notions, such as algorithm, computability, decidability, and complexity through problem solving.

3. Prove the basic results of the Theory of Computation. State and explain the relevance of the Church-Turing thesis.

4. To solve various problems of applying normal form techniques, push down automata and Turing Machines

5. To Construct context free grammar for various languages
6. To Design Finite Automata's for different Regular Expressions and Languages

**Topic Covered**

**UNIT-I** **9L**

Alphabets, Strings and Languages, Automata and Grammars, Deterministic Finite Automata (DFA)-Formal Definition, Simplified Notation: State Transition Graph, Transition Table, Language of DFA, Nondeterministic Finite Automata (NFA), NFA with Epsilon Transition, Equivalence of NFA and DFA, Minimization of Finite Automata, Myhill-Nerode Theorem

**UNIT-II** **9L**

Regular Expression (RE), Definition, Operators of Regular Expression and their Precedence, Algebraic Laws for Regular Expressions, Kleen"s Theorem, Regular Expression to FA, DFA to Regular Expression, Arden Theorem, Non Regular Languages, Pumping Lemma for Regular Languages. Application of Pumping Lemma, Closure Properties of Regular Languages, Decision Properties of Regular Languages, FA with Output: Moore and Mealy Machine, Equivalence of Moore and Mealy Machine, Applications and Limitation of FA.

**UNIT-III** **9L**

Context Free Grammar (CFG) and Context Free Languages (CFL): Definition, Examples, Derivation, Derivation Trees, Ambiguity in Grammer, Inherent Ambiguity, Ambiguous to Unambiguous CFG, Useless Symbols, Simplification of CFGs, Normal Forms for CFGs: CNF and GNF, Closure Proper ties of CFLs, Decision Properties of CFLs: Emptiness, Finiteness and Membership, Pumping Lemma for CFLs.

Push Down Automata (PDA): Description and Definition, Instantaneous Description, Language of PDA, Acceptance by Final State, Acceptance by Empty Stack, Deterministic PDA, Equivalence of PDA and CFG, CFG to PDA and PDA to CFG, Two Stack PDA

**UNIT-IV** **9L**

Turing Machines (TM): Basic Model, Definition and Representation, Instantaneous Description, Language Acceptance by TM, Variants of Turing Machine, TM as Computer of Integer Functions, Universal TM, Church‟s Thesis, Recursive and Recursively Enumerable Languages, Halting Problem, Introduction to Undecidability, Undecidable Problems about TMs. Post Correspondence Problem (PCP), Modified PCP, Introduction to Recursive Function Theory.

**Textbooks**

1. Micheal Sipser, “Introduction to the Theory of Computation”, Thomson Learning

Reference books

1. Hopcroft, Ullman, “Introduction to Automata Theory, Languages and Computation”, Pearson Education

2. Peter Linz, "An Introduction to Formal Language and Automata", Narosa Publishing house

3. H R. Lewis and Christos H. Papadimitriou, “Elements of the theory of Computation”, PHI Ltd

**BCS-253** **Design & Analysis of Algorithms**

| | |
|---|---|
| **Course Category** | PC |
| **Pre-requisite Subject** | NIL |
| **Contact Hours/Week** | Lecture: 3, Tutorial: 1 & Practical: 2 |
| **Number of Credits** | 5 |
| **Course Assessment Methods** | Continuous Assessment through Two Tests, Teacher Assessment (Quiz, Tutorial, Assignment, Attendance), Practical Work & Viva-voce, and One Major Theory & One Practical Examinations. |

**Course Objective:** This course helps the students in gaining the knowledge of basic principle of design and analysis of algorithms. This course helps to undertake future courses that assume as a background in data structures and algorithm design.

1. Discuss basic theory and practice of algorithms
2. Design and implement new algorithms
3. Become familiar with fundamental data structures and with the way these data structures can best be implemented
4. Become accustomed to the description of algorithms in both functional and procedural styles

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

1. Define the basic concepts of algorithms and analyze the performance of algorithms.
2. Discuss various algorithm design techniques for developing algorithms.
3. Discuss various searching, sorting and graph traversal algorithms.
4. Understand NP completeness and identify different NP complete problems.
5. Discuss various advanced topics on algorithm
6. Able to Compare between different data structures and pick an appropriate data structure for a design situation.

**TOPIC COVERED**

**UNIT-I** **9L**

Introduction: Algorithms, Analyzing Algorithms, Complexity of Algorithms, Growth of Functions, Performance Measurements, Sorting and Order Statistics - Shell Sort, Quick Sort, Merge Sort, Heap Sort, Comparison of Sorting Algorithms, Sorting in Linear Time. Divide And Conquer strategy with Examples such as Sorting, Matrix Multiplication, Convex Hull and Searching.

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**UNIT-II** **9L**

Greedy Methods with Examples such as Optimal Reliability Allocation, Knapsack, Minimum Spanning Trees – Prim's and Kruskal's Algorithms, Single Source Shortest Paths – Dijkstra's and Bellman Ford Algorithms.

Dynamic Programming with Examples such as Multistage Graphs, Knapsack, All Pair Shortest Paths -Warshal's and Floyd's Algorithms, Resource Allocation problem

**UNIT-III** **9L**

Backtracking, Branch and Bound with Examples such as Travelling Salesman Problem, Graph Coloring, N-Queen Problem, Hamiltonian Cycles and Sum of Subsets

Advanced Data Structures***:*** Red-Black Trees, B – Trees, Binomial Heaps, Fibonacci Heaps

**UNIT-IV** **9L**

Selected Topics: String Matching, Text Processing- Justification of Text, Theory of NP-Completeness, Approximation Algorithms and Randomized Algorithms, Algebraic Computation, Fast Fourier Transform

**EXPERIMENTS**

1. To analyze time complexity of Insertion sort.
2. To analyze time complexity of Quick sort.
3. To analyze time complexity of Merge sort.
4. To Implement Largest Common Subsequence.
5. To Implement Matrix Chain Multiplication.
6. To Implement Strassen's matrix multiplication Algorithm, Merge sort and Quick sort.
7. To implement Knapsack Problem.
8. To implement Activity Selection Problem.
9. To implement Dijkstra's Algorithm.
10. To implement Warshall's Algorithm.
11. To implement Bellman Ford's Algorithm.
12. To implement Naïve String Matching Algorithm.
13. To implement Rabin Karp String Matching Algorithm
14. To implement Prim's Algorithm.
15. To implement Kruskal's Algorithm.

**TEXTBOOKS**


1. Thomas H. Coreman, Charles E. Leiserson and Ronald L. Rivest, Introduction to Algorithms, PHI
2. RCT Lee, SS Tseng, RC Chang, and YT Tsai, "Introduction to the Design and Analysis of Algorithms", McGraw Hill 2005
3. Ellis Horowitz and Sartaj Sahni, *Fundamentals of Computer Algorithms*, Computer Science Press, Maryland 1978
4. Berman, Paul," Algorithms", Cengage Learning, PHI
5. Aho, Hopcraft, Ullman, "The Design and Analysis of Computer Algorithms" Pearson Education, 2008


**REFERENCE BOOKS**


1. Berlion, P. Izard, P., Algorithms-The Construction, Proof and Analysis of Programs, 1986. Johan Wiley & Sons
2. Ellis Horowitz, Sartaj Sahni, and Sanguthevar Rajasekaran, *Computer Algorithms*, W. H. Freeman, NY, 1999
3. Goodman, S.E. & Hedetnien, introduction to Design and Analysis of Algorithms, 1997 MGH
4. Knuth, D. E, Fundamentals of Algorithms: The Art of Computer Programming Vol, 1985

**BCS- 254 COMPUTER ORGANIZATION AND ARCHITECTURE**

| | |
|---|---|
| **Course Category** | Department Core (DC) |
| **Pre-requisite Subject** | NIL |
| **Contact Hours/Week** | Lecture: 3, Tutorial: 1 & Practical: 2 |
| **Number of Credits** | 5 |
| **Course Assessment Methods** | Continuous Assessment through Two Tests, Teacher Assessment (Quiz, Tutorial, Assignment, Attendance), Practical Work & Viva-voce, and One Major Theory & One Practical Examinations. |

**Course Objectives:** This course helps the students in gaining the knowledge of Computer Organization and Architecture. The principal objectives of this course are:

1. To understand the structure, function and characteristics of computer systems.
2. To understand the design of the various functional units and components of computers.
3. To explain the function of each element of a memory hierarchy,
4. To identify and compare different methods for computer I/O.

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

1. To study the design of arithmetic and logic unit and implementation of fixed point and floating-point arithmetic operations
2. To study the two types of control unit techniques and the concept of Pipelining
3. To study the hierarchical memory system including cache memories and virtual memory
4. To study the different ways of communicating with I/O devices and standard I/O interfaces
5. Elaborate advanced concepts of computer architecture, Parallel Processing, interprocessor communication and synchronization
6. Describe the operations and language of the register transfer, micro operations and input-output organization.

**Topics Covered**

**UNIT-I** **9L**

Basics: Functional Blocks in a Computer System, Floating point representation - Precision and Accuracy, Computer Arithmetic, Addressing Modes, Instruction Set and Instruction Execution Flow, Instruction Format, Instruction Set Design, Data Transfer & Manipulations operations, Arithmetic and Logic operations, Shift Micro-Operation.

**UNIT-II** **9L**

Design of Arithmetic Circuits: Addition & Subtraction of Signed Numbers, Multiplication, Integer Division, Fast Adder and Fast multipliers, Floating Point Operations, Decimal Arithmetic Unit, Decimal Arithmetic Operations, Arithmetic and Instruction Pipeline, its Performance.

Control Design: Hardwired control design, Micro Programmed Control Unit, Micro-instruction design.

**UNIT-III** **9L**

Characteristics of memory system, Memory hierarchy, Cache Memory- Cache memory principles, Elements of cache design- cache address, size, mapping functions, replacement algorithms, write policy, Internal Memory- Main Memory (RAM and ROM Chips), semiconductor memory, External Memory- Hard Disk organization, RAID, Virtual Memory concept.

**UNIT-IV** **9L**

I/O modules- Module function and I/O module structure, Programmed I/O, Polling I/O, Interrupt driven I/O, DMA function, Synchronous and Asynchronous serial data communication, Computer peripherals like keyboard, mouse, printer, scanner, and display devices.

**EXPERIMENTS**

1. Implementing HALF ADDER, FULL ADDER using basic logic gates
2. Implementing Binary -to -Gray, Gray -to -Binary code conversions.
3. Implementing 3-8 line DECODER.
4. Implementing 4x1 and 8x1 MULTIPLEXERS.
5. Verify the excitation tables of various FLIP-FLOPS.
6. Design of an 8-bit Input/ Output system with four 8-bit Internal Registers.
7. Design of an 8-bit ARITHMETIC LOGIC UNIT.
8. Design the data path of a computer from its register transfer language description.
9. Design the control unit of a computer using either hardwiring or microprogramming based on its register transfer language description.
10. Implement a simple instruction set computer with a control unit and a data path.

**Textbooks**


1. Computer System Architecture - M. Mano
2. Carl Hamacher, Zvonko Vranesic, Safwat Zaky Computer Organization, McGraw-Hill, Fifth Edition, Reprint 2012
3. John P. Hayes, Computer Architecture and Organization, Tata McGraw Hill, Third Edition, 1998.


**Reference books**


1. William Stallings, Computer Organization and Architecture-Designing for Performance, Pearson Education, Seventh edition, 2006.
2. Behrooz Parahami, “Computer Architecture”, Oxford University Press, Eighth Impression, 2011.
3. David A. Patterson and John L. Hennessy, “Computer Architecture-A Quantitative Approach”, Elsevier, a division of reed India Private Limited, Fifth edition, 2012.


**BEC-256 SIGNALS & SYSTEMS**

**Course category** : PLBSE

| | | |
|---|---|---|
| **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 Minor tests and Major Theory Examination |
| **Course Outcomes** | : | The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course |

1. Able to describe the signals and systems mathematically and understand how to perform mathematical operations on signals and systems.
2. Able to analyze spectral characteristics and system properties based on impulse response and Fourier analysis.
3. Apply the Laplace transform and Z- transform for analyzing of continuous-time and discrete-time signals and systems.
4. Able to apply the transformation tools (continuous and discrete) on the analysis of spectral densities, design of system function and its block diagram representation.
5. Able to analyze the time domain effects on the continuous and discrete systems.
6. Able to analyze the frequency domain effects on the continuous and discrete systems.

**Topics Covered**

**UNIT-I** 9

**Signals:** Definition, types of signals and their representations: Continuous-time/discrete-time, Periodic/non-periodic, Even/Odd, Energy/Power, Deterministic/Random, One dimensional /Multidimensional, Commonly used signals (in continuous-time as well as in discrete-time): Unit impulse, Unit step, unit ramp (and their interrelationships), Exponential, Rectangular pulse, Sinusoidal; Operations on continuous-time and discrete-time signals (including transformations of independent variables).

**Systems:** Classification, Linearity, Time-invariance and causality, Impulse response, Characterization of linear time-invariant (LTI) systems, Unit sample response, Convolution summation, Step response of discrete time systems, Stability, Poles and zeros

**UNIT-II** 9

**Fourier Series (FS) and Fourier Transforms (FT):**

(i) Fourier series representation and some important properties (ii) Definition, conditions of existence of FT, properties, Magnitude and phase spectra, Some important FT theorems, Parseval's theorem, Inverse FT (iii) Discrete time Fourier

transform (DTFT), Inverse DTFT, Convergence, Properties and theorems, Comparison between continuous time FT and DTFT

**UNIT-III**

**Laplace-Transform (LT) and Z-transform (ZT):** (i) One-sided LT of some common signals, Important theorems and properties of LT, inverse LT, Solutions of differential equations using LT, Bilateral LT, Regions of convergence (ROC) (ii) One sided and Bilateral Z-transforms, ZT of some common signals, ROC, Properties and theorems, Solution of difference equations using one-sided ZT, s- to Z-plane mapping 9

**UNIT-IV** 9

**Time and frequency domain analysis of systems**

Convolution integral, Co-relations, Signal energy and energy spectral density, signal power and power spectral density, Properties of power spectral density, Analysis of first order and second order systems, continuous-time (CT) system analysis using LT, System functions of CT systems, Block diagram representations; discrete-time system functions, block diagram representation, Illustration of the concepts of system bandwidth and rise time through the analysis of a first order CT low pass filter

Text Books:


1. M. J. Roberts, "Fundamentals of Signals and Systems", Tata McGraw Hill, 2007.
2. A.V. Oppenheim, A.S. Willsky and H.S. Nawab, "Signals and Systems", Prentice Hall of India, 2006.
3. B. P. Lathi,"Signal Processing and Linear Systems", Oxford University Press, 1998.


Reference Books


1 R.F. Ziemer, W.H. Tranter and D.R. Fannin, "Signals and Systems - Continuous and Discrete", 4/e, Prentice Hall, 1998.

2 Simon Haykin, Barry van Veen, "Signals and Systems", John Wiley and Sons, 1998.


## SCS- 211 Introduction to Data Science

| | |
|---|---|
| **Course Category** | DM |
| **Pre-requisite Subject** | NIL |
| **Contact Hours/Week** | Lecture: 3, Tutorial: 0 & Practical: 0 |
| **Number of Credits** | 3 |
| **Course Assessment Methods** | Continuous Assessment through Two Tests, Teacher Assessment (Quiz, Tutorial, Assignment, Attendance), and One Major Theory Examination. |

**Course Objective:**

1. To Provide the knowledge and expertise to become a proficient data scientist.

2. Demonstrate an understanding of statistics and machine learning concepts that are vital for data science.
3. Produce Python code to statistically analyse a dataset.

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

1. To explain how data is collected, managed, and stored for data science.
2. To understand the key concepts in data science, including their real-world applications and the toolkit used by data scientists.
3. To implement data collection and management scripts using MongoDB.
4. Critically evaluate data visualisations based on their design and use for communicating stories from data.
5. Evaluate outcomes and make decisions based on data
6. Effectively communicate results

**TOPIC COVERED**

**UNIT-I** **9L**

Introduction to Data Science, Different Sectors using Data science, Purpose and Components of Python in Data Science. Applications of Data Science, Data Science and Ethical Issues- Discussions on privacy, security, ethics- A look back at Data Science- Next-generation data scientists.

**UNIT-II** **9L**

Data Analytics Process, Knowledge Check, Exploratory Data Analysis (EDA), EDA- Quantitative technique, EDA- Graphical Technique, Data Analytics Conclusion and Predictions.

**UNIT-III** **9L**

Feature Generation and Feature Selection (Extracting Meaning from Data)- Motivating application: user (customer) retention- Feature Generation (brainstorming, role of domain expertise, and place for imagination)- Feature Selection algorithms.

**UNIT-IV** **9L**

Data Visualization- Basic principles, ideas and tools for data visualization, Examples of inspiring (industry) projects- Exercise: create your own visualization of a complex dataset.

**EXPERIMENTS**

19. Python Environment setup and Essentials.
20. Mathematical computing with Python (NumPy).
21. Scientific Computing with Python (SciPy).
22. Data Manipulation with Pandas.
23. Prediction using Scikit-Learn.
24. Data Visualization in python using matplotlib.

**TEXTBOOKS**


3. Data Science from Scratch: First Principles with Python, Joel Grus, O'Reilly Media (2015).
4. An introduction to Data Science, Jeffrey Stanton.
5. Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython 2nd edition, William McKinney, O'Reilly Media (2017)

6. Business Analytics: The Science of Data - Driven Decision Making, U Dinesh Kumar, John Wiley & Sons.
7. Introducing Data Science: Big Data, Machine Learning, and More, Using Python Tools, Davy Cielen, John Wiley & Sons.
8. Data Science from Scratch, Joel Grus, O'Reilly Publisher Media.

**REFERENCE BOOK**

9. Mining of Massive Datasets. v2.1, Jure Leskovek, Anand Rajaraman and Jeffrey Ullman. , Cambridge University Press.
10. Python Data Science Handbook, Jake VanderPlas, Shroff Publisher/O'Reilly Publisher Media.
11. Data Analysis with Open Source Tools, Philipp Janert, Shroff Publisher/O'Reilly Publisher Media.

**SCS- 221 Introduction to Security of Cyber-Physical Systems**

| | |
|---|---|
| **Course Category** | DM |
| **Pre-requisite Subject** | NIL |
| **Contact Hours/Week** | Lecture: 3, Tutorial: 0 & Practical: 0 |
| **Number of Credits** | 3 |
| **Course Assessment Methods** | Continuous Assessment through Two Tests, Teacher Assessment (Quiz, Tutorial, Assignment, Attendance), and One Major Theory Examination. |

**Course Objective:**

1. To learn the basics of security and various types of security issues.
2. To study different cryptography techniques available and various security attacks.
3. Explore network security and how they are implemented in real world.
4. To get an insight of various issues of Web security and biometric authentication.

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

1. To Apply basics of security and issues related to it.
2. To use biometric techniques available and how they are used in today's world.
3. To investigate Security issues in web and how to tackle them.
4. To Learn mechanisms for transport and network security
5. Understand abstraction in system designs
6. Express pre- and post-conditions and invariants for CPS models

**TOPIC COVERED**

**UNIT-I** **9L**

Overview of Security and Privacy in Information System, Applied Cryptography & Intrusion Detection, Architecture of Applied Cryptography, One Way Hash Function and Integrity, Encryption Algorithms and Confidentiality, Digital Signature and Authentication (DH, RSA, 2 class), Intrusion Detection and Information Theory.

**UNIT-II** **9L**

Internet of Things Security, Security and Privacy for IoT Case Study: Smart Home, Smart Grid Network, Modern Vehicle, Wearable Computing & BYOD, Mobile HealthCare.

**UNIT-III** **9L**

Software-Defined Networks, Introduction of Software-Defined Networks, Security for Software-Defined Networks, Privacy Leakages for Software-Defined Networks, Case Studies: How to Attack Software-Defined Networks.

**UNIT-IV** **9L**

Cyber-Physical Systems (CPS), CPS - Platform components, CPS implementation issues, Intelligent CPS, Secure Deployment of CPS.

**TEXTBOOKS**

1. Cyber Security, Nina Godbole, John Wiley & Sons.
2. Li Da Xu, Shancang Li, "Securing the Internet of Things", Syngress.
3. Alasdair Gilchrist, "IoT Security Issues", De Gruyter

**REFERENCE BOOK**

1. Sean Smith, "The Internet of Risky Things", Sean Smith, Shroff Publisher/O'Reilly Publisher

**SCS- 231 Computer Graphics for Virtual Reality**

| | |
|---|---|
| **Course Category** | DM |
| **Pre-requisite Subject** | NIL |
| **Contact Hours/Week** | Lecture: 3, Tutorial: 0 & Practical: 0 |
| **Number of Credits** | 3 |
| **Course Assessment Methods** | Continuous Assessment through Two Tests, Teacher Assessment (Quiz, Tutorial, Assignment, Attendance), and One Major Theory Examination. |

**Course Objective:**

1. To introduce the use of the components of a graphics system and become familiar with building approach of graphics system components and algorithms related with them.
2. To learn the basic principles of 3-dimensional computer graphics.
3. Provide an understanding of mapping from a world coordinates to device coordinates, clipping, and projections.

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

1. To list the basic concepts used in computer graphics.
2. To implement various algorithms to scan, convert the basic geometrical primitives, transformations, Area filling, clipping.
3. To define the fundamentals of animation, virtual reality and its related technologies.
4. To design an application with the principles of virtual reality.
5. To understand a typical graphics pipeline
6. To design an application with the principles of virtual reality

**TOPIC COVERED**

**UNIT-I** **9L**

Graphics system and models: applications of computer graphics, graphics system, physical and synthetic images, imaging systems, graphics architectures, Geometric objects and transformations: scalars, points and vectors, three-dimensional primitives, coordinate systems and frames, frames in OpenGL, matrix and vector classes, modelling a colored cube, affine transformations - translation, rotation and scaling, transformations in homogeneous coordinates, concatenation of transformations, transformation matrices in OpenGL, interfaces to 3D applications, quaternion.

Vertices to fragments: basic implementation strategies, four major tasks, clipping - line clipping, polygon clipping, clipping of other primitives, clipping in three dimensions, polygon rasterization, hidden-surface removal, antialiasing, display considerations.

**UNIT-II** **9L**

Lighting and shading: light and matter, light sources, the Phong reflection model, computation of vectors, polygonal shading, approximation of a sphere by recursive subdivision, specifying lighting parameters, implementing a lighting model, shading of the sphere model, per-fragment lighting, global illumination.

Hierarchical modelling: symbols and instances, hierarchical models, a robot arm, trees and traversal, use of tree data structures, other tree structures, scene graphs, open scene graph. **UNIT-III** **9L**

Discrete techniques: buffers - digital images - writing into buffers - mapping methods - texture mapping - texture mapping in OpenGL - texture generation - environment maps - reflection map - bump mapping - compositing techniques - sampling and aliasing.

Advanced rendering: going beyond pipeline rendering - ray tracing - building a simple ray tracer - the rendering equation - radiosity - Renderman - parallel rendering -volume rendering - Isosurfaces and marching cubes - mesh simplification - direct volume rendering - image-based rendering.

**UNIT-IV** **9L**

Fractals: modelling - Sierpinski Gasket - coastline problem - fractal geometry - fractal dimension - recursively defined curves - Koch curves - c curves - dragons - space filling curves - turtle graphics - grammar based models - Graftals - volumetric examples - k-midpoint subdivision - fractal Brownian motion - fractal mountains - iteration in the complex plane - Mandelbrot set.

Virtual reality modelling language: introduction, exploring and building a world, building object, lighting, sound and complex shapes, animation and user interaction, colors, normals and textures, nodes references. Special applications: stereo display programming, multiport display systems, multi-screen display system, fly mode navigation, walk through navigation, virtual track ball navigation.

**TEXTBOOKS**


1. Rajesh K. Maurya, Computer Graphics with Virtual Reality System, John Wiley & Sons.
2. Edward Angel, “Interactive Computer Graphics: A Top-Down Approach Using OpenGL”, Addison-Wesley.
3. Foley James D, Van Dam, Feiner and Hughes, “Computer Graphics: Principles and Practice”, Pearson Education.


**REFERENCE BOOK**


4. Sean Smith, “The Internet of Risky Things”, Sean Smith, Shroff Publisher/O’Reilly Publisher.

**BHM-301/ 351** **ENGINEERING AND MANAGERIAL ECONOMICS**

| | | |
|---|---|---|
| **Course category** | : | HMSD |
| **Pre-requisite Subject** | : | NIL |
| **Contact hours/week** | : | Lecture : 2, Tutorial : 0, Practical: 0 |
| **Number of Credits** | : | 2 |
| **Course Assessment methods** | : | Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination |
| **Course Objective** | : | 1. To make fundamentally strong base for decision making skills by applying the concepts of economics.<br>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.<br>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.<br>4. Be equipped with the tools necessary in forecasting product demand.<br>5. Understand and analyze the macro environment affecting the business decision making.<br>6. To make students understand basic elements of Indian Economy. |
| **Course Outcomes** | : | The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course |

1. Students will acquire basic knowledge in Engineering & managerial economics, which allows students to gain theoretical and empirical skill of economics.
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.
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.
4. Students will acquire practical knowledge of economics, the kind of markets, cost theory, various issues of demand and other major economic concepts.
5. Able to explain succinctly the meaning and definition of managerial economics; elucidate on the characteristics and scope of managerial economics.
6. Able to describe the techniques of managerial economics.
7. Able to explain the applications of managerial economics in various aspects.
8. To learn about the management and economics of the industrial environment

## Syllabus

**UNIT-I**

6

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.

**UNIT-II**

**Theory of Demand**: 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 **Demand Forecasting:** Qualitative and Quantitative Techniques of forecasting.

**UNIT-III**

**Theory of Supply**: Law of Supply, Supply Function, Supply Schedule, Supply Curve, Factors, affecting Supply.

**Types of cost:** fixed cost, variable cost, average cost, marginal cost, opportunity cost, Economies of scale.

**UNIT-IV**

**Market Structure:** Perfect Competition, Imperfect competition – Monopolistic, Oligopoly, Monopoly, Meaning of Inflation, Types o Inflation, Causes of inflation, Deflation, Business cycle.

**Books & References**


1. Mote, Paul and Gupta, Managerial Economics, T M H, New Delhi.
2. H L Ahuja, Managerial Economics, S Chand & Co. New Delhi
3. P.L. Mehta, Managerial Economics, Analysis, Problems and Cases, Sultan Chai Sons, NewDelhi.
4. Prof. D.N. Kakkar , Managerial Economics for Engineering, PHI publication, New De
5. Varshney and Maheshwari, Managerial Economics, Sultan Chand and Sons, New Del


**BCS-301 Principles of Operating Systems**

| | |
|---|---|
| **Course Category** | PC |
| **Pre-requisite Subject** | NIL |
| **Contact Hours/Week** | Lecture: 3, Tutorial: 0 & Practical: 2 |
| **Number of Credits** | 4 |
| **Course Assessment Methods** | Continuous Assessment through Two Tests, Teacher Assessment (Quiz, Tutorial, Assignment, Attendance), Practical Work & Viva-voce, and One Major Theory & One Practical Examinations. |

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**Course Objective:** This course helps the students in gaining the knowledge to basic principle of operating systems. This course helps to undertake future courses that assume as a background in management of system resources.

1. Discuss basic theory and practice of algorithms
2. Learn how OS concepts are implemented in a real operating system
3. Introduce systems programming
4. Learn current trends in OS research
5. Be familiar with issues in the design of operating systems

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

1. Understand the structure and functions of OS.

2. Learn about Processes, Threads and Scheduling algorithms.
3. Understand the principles of concurrency and deadlocks
4. Learn various memory management scheme
5. Study I/O management and File systems
6. Recognize file system interface, protection and security mechanisms.

**TOPIC COVERED**

**UNIT-I** **9L**

**Operating Systems Overview**-Components, Goals of Designer, System Structures, User Services, Interrupt Systems and Device Programming-Interrupt Sources and Priorities, Interrupt Service Routines, Hardware Support - Machine States, Context Switching, Privileged Instructions and registers

.

**UNIT-II** **9L**

**Memory Management**-Major Issues: Fetch, Placement, Contiguity, Relocation Adjustment, Paging and Virtual Memory, Translate-Look-Aside Buffer (Associative Memory), Single and Multi-Level Page Tables, Paging with Segmentation, Problems of Large Address Spaces and How They Are addressed.

**Virtual Storage Management**- Storage Hierarchy, Cache Usage, Partial Residency, Page Replacement Strategies, Working sets

**UNIT-III** **9L**

**Concurrency Problems and Solutions**- Critical Section Problem, Process Synchronization and Coordination, Semaphores, Special Instructions, Monitors, Inter-process Communication, Remote Procedure Calls, Special Problems of Transaction-Based Systems

**Deadlock and Resource Conflict**- Prevention, Avoidance, Detection, Recovery

**Process and Thread Management**-Process/Thread Creation and Termination, Process/Thread States and Their Transitions

CPU Scheduling Algorithms, Non-Preemptive Approaches, Preemptive Approach, Multi-Processor considerations

**UNIT-IV** **9L**

**Physical Storage Management**- Disk Scheduling Algorithms, Disk Performance Features, Disk Reliability Concerns

**File System Organization** - The Boot Record - Where Things Start, Directory Organization, File Descriptors, Access Control Backup

**System Security**-Principle of Least Privilege, Threats and Vulnerabilities, Protection Mechanisms - Access and Capability Control, User (Subject) Authentication, Levels of Security in "Trusted" Systems, Confinement problem.

**EXPERIMENTS**

1. Study of hardware and software requirements of different operating systems (UNIX, LINUX, various version of WINDOWS

2. Execute various UNIX system calls for
    a. Process management
    b. File management
    c. Input/output Systems calls
3. Implement CPU Scheduling Policies:
    a. SJF Priority
    b. FCFS
    c. Multi-level Queue
4. Implement file storage allocation technique:
    a. Contiguous (using array)
    b. Linked –list (using linked-list)
    c. Indirect allocation (indexing)
5. Implementation of contiguous allocation techniques:
    a. Worst-Fit
    b. Best- Fit
    c. First- Fit
6. Calculation of external and internal fragmentation
    a. Free space list of blocks from system
    b. List process file from the system
7. Implementation of compaction for the continually changing memory layout and calculate total movement of data
8. Implementation of resource allocation graph RAG)
9. Implementation of Banker's algorithm
10. Conversion of resource allocation graph (RAG) to wait for graph (WFG) for each type of method used for storing graph.
11. Implement the solution for Bounded Buffer (producer-consumer) problem using inter process communication techniques-Semaphores
12. Implement the solutions for Readers-Writers problem using inter process communication technique -Semaphore

**TEXTBOOKS**


1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, Operating System Concepts, John Wiley & Sons (ASIA) Pvt. Ltd, Seventh Edition 2005
2. Pramod Chandra and P. Bhatt, "An Introduction to Operating Systems Concepts and Practice", Prentice Hall India,3rd edition 2010


**REFERENCE BOOKS**


1. Milenekovie, Operating System Concept, McGraw Hill
2. Harvey M. Deitel, Paul J. Deitel, and David R. Choffnes, Operating Systems, Prentice Hall, Third edition2003
3. Petersons, "Operating Systems", Addison Wesley
4. Andrew S. Tannenbaum & Albert S. Woodhull, "Operating System Design and Implementation", Prentice Hall, 3rd Edition, 2006

5. William Stallings, Operating Systems – internals and design principles, Prentice Hall, 7thEdition, 2011
6. Gary J. Nutt, "Operating Systems", Pearson/Addison Wesley, 3rd Edition2004
7. Andrew S. Tannenbaum, "Modern Operating Systems", Prentice Hall,3rd Edition 2007
8. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, Operating System Concepts, John Wiley & Sons (ASIA) Pvt. Ltd, Seventh Edition, 2005

**BCS- 302** **PRINCIPLE OF COMPILER DESIGN**

| | |
|---|---|
| **Course Category** | Department Core (DC) |
| **Pre-requisite Subject** | NIL |
| **Contact Hours/Week** | Lecture: 3, Tutorial: 1 & Practical: 2 |
| **Number of Credits** | 5 |
| **Course Assessment Methods** | Continuous Assessment through Two Tests, Teacher Assessment (Quiz, Tutorial, Assignment, Attendance), Practical Work & Viva-voce, and One Major Theory & One Practical Examinations. |

**Course Objectives:** This course helps the students in gaining the knowledge of Computer Organization and Architecture. The principal objectives of this course are:

1. Provide an understanding of the fundamental principles in compiler design
2. Provide the skills needed for building compilers for various situations that one may encounter in a career in Computer Science.
3. Learn the process of translating a modern high-level language to executable code required for compiler construction.

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

1. Understand fundamentals of compiler and identify the relationships among different phases of the compiler.
2. Understand the application of finite state machines, recursive descent, production rules, parsing, and language semantics.
3. Analyze & implement required module, which may include front-end, back-end, and a small set of middle-end optimizations.
4. Use modern tools and technologies for designing new compiler.
5. To understand how linker and loader create an executable program from an object module created by assembler and compiler.
6. Design the structures and support required for compiling advanced language features

**Topics Covered**

**UNIT-I** **9L**

Compiler Structure: Analysis-Synthesis Model of Compilation, Various Phases of a Compiler, Tool Based Approach to Compiler Construction Lexical Analysis: Interface with Input, Parser and

Symbol Table, Token, Lexeme and Patterns, Difficulties in Lexical Analysis, Error Reporting, and Implementation. Regular Definition, Transition Diagrams, LEX.

**UNIT-II** **9L**

Syntax Analysis: Context Free Grammars, Ambiguity, Associativity, Precedence, Top Down Parsing, Recursive Descent Parsing, Transformation on the Grammars, Predictive Parsing, Bottom Up Parsing, Operator Precedence Grammars, LR Parsers (SLR, LALR, LR), YACC.

**UNIT-III** **9L**

Syntax Directed Definitions: Inherited and Synthesized Attributes, Dependency Graph, Evaluation Order, Bottom Up and Top Down Evaluation Of Attributes, L- and S-Attributed Definitions.

Type Checking: Type System, Type Expressions, Structural and Name Equivalence of Types, Type Conversion, Overloaded Functions and Operators, Polymorphic Functions.

Intermediate Code Generation: Intermediate Representations, Translation of Declarations, Assignments Intermediate Code Generation For Control Flow, Boolean Expressions and Procedure Calls, Implementation Issues.

**UNIT-IV** **9L**

Symbol Table Management, Runtime Environments, Source Language Issues, Storage Organization, Storage Allocation Strategies, Access to Non-Local Names, Parameter Passing. Code Optimization, Peephole Optimization, Source of Optimizations, Optimization of Basic Blocks, Loops, Global Dataflow Analysis, Introduction to Code Generation.

**EXPERIMENTS**

1. Write a program using Lex to calculate the number of characters, number of words and the number of lines present in the given text file as input.
2. Write a program using Lex to implement the set of regular expression and indicates the acceptance of a given string for a particular regular expression.
3. Write a C program to implement the conversion of regular expression to non-deterministic finite automation
4. Write a program using Yacc to check whether a string belong to the given grammar or not.
5. Write a C program to compute FIRST and FOLLOW of the non-terminals of given grammar.
6. Write a C program to check the given grammar is Left recursive and remove Left recursion.
7. Write Syntax Directed Translation actions using Yacc to generate Parse Tree for the grammar for arithmetic expressions.

8. Write Syntax Directed Translation actions using Yacc to translate arithmetic expressions into Postfix form.
9. Write Syntax Directed Translation actions using Yacc to translate arithmetic expressions into three address code.

**Textbooks**


1. A.V. Aho, M.S. Lam, R. Sethi, and J.D. Ullman, Compilers: Principles, Techniques, and Tools, Pearson Education, 2007 (second ed.).
2. K.D. Cooper, and L. Torczon, Engineering a Compiler, Elsevier, 2004.


**Reference books**


1. AW Appel, J Palsberg, Modern Compiler Implementation in JAVA, Cambridge University Press, 2002

AW Appel, M Ginsburg, Modern Compiler Implementation in C, Cambridge


## BCS-303 COMPUTER NETWORKS

| | |
|---|---|
| **Course Category** | PC |
| **Pre-requisite Subject** | NIL |
| **Contact Hours/Week** | Lecture: 3, Tutorial: 0 & Practical: 2 |
| **Number of Credits** | 4 |
| **Course Assessment Methods** | Continuous Assessment through Two Tests, Teacher Assessment (Quiz, Tutorial, Assignment, Attendance), Practical Work & Viva-voce, and One Major Theory & One Practical Examinations. . |

**Course Objective:**

1. The objective of the course is to equip the students with a general overview of the concepts and fundamentals of computer networks.
2. Familiarize the students with the standard models for the layered approach to communication between machines in a network and the protocols of the various layers.
3. Understand basic network models and Different transmission used for data communication.
4. Recognize the data link design issues and various data link protocols used for data transmission.

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

1. Understand OSI and TCP/IP models.
2. Analyze MAC layer protocols and LAN technologies.
3. Design applications using Internet protocols.
4. Implement routing and congestion control algorithms.
5. Develop application layer protocols.

6. Understand different routing algorithms used for data transmission from source to destination in a network layer.

**TOPIC COVERED**

**UNIT-I** **9L**

Data Communication Concepts, Introduction to Networks and Layered Architecture, Protocols and Standards, Reference models-OSI Reference Model and TCP/IP Reference Model. A Comparison of the OSI and TCP/IP Reference Models, Transmission Media and Networks Topology, Multiplexing- Frequency Division, Time Division and Wave Division, Circuit Switching and Packet Switching, Goals and Applications of Networks, LAN: Wired LAN, Wireless LANs, LAN Inter Connection Devices.

**UNIT-II** **9L**

Medium Access Sub Layer: Channel Allocations, LAN Protocols, ALOHA Protocols- Pure ALOHA, Slotted ALOHA, Carrier Sense Multiple Access Protocols, CSMA with Collision Detection, Collision Free Protocols, IEEE Standards, Ethernet, FDDI, Data Link Layer- Basic Design Issues, Error Correction & Detection Algorithms, Elementary Data Link Layer Protocols, Sliding Window Protocols, Error Handling, High Level Data Link Control.

**UNIT-III** **9L**

Network Layer: Packet Switched Networks – IP – ARP – RARP –DHCP – ICMP – Queuing Discipline – Routing Algorithms, Congestion Control Algorithms, Internetworking, TCP/IP Protocol, IP Addresses, IPv4 and IPv6.

**UNIT-IV** **9L**

Transport Layer: Design Issues, Connection Management, Internet Transport Protocol (UDP), Transmission Control Protocol. (TCP) -Adaptive Retransmission Congestion Control, Congestion Avoidance – Quality of Service (QOS).

Application Layer: Domain Name System, Electronic Mail (Email), File Transfer Protocol, Hyper Text Transfer Protocol, Introduction to Cryptography and Network Security.

**EXPERIMENTS**

1. To create scenario and study the performance of CSMA/CD protocol through simulation.
2. To create scenario and study the performance of token bus and token ring protocols through simulation.
3. Implementation of Error detection and correction algorithms.
4. Implementation and study of 1-bit sliding window viz., stop and wait protocol.
5. Implementation and study of Go back-N protocol.
6. Implementation and study of Selective repeat protocol.
7. To get the MAC or Physical address of the system using Address Resolution Protocol.
8. Implementation of distance vector routing algorithm.
9. Implementation of link state routing algorithm.
10. To write a client-server application for chat using TCP.
11. To Write connection oriented Client server applications with TCP.

12. To write connectionless Client server applications with UDP.

**TEXTBOOKS**

1. Behrouz A. Forouzan, Data Communication and Networking, McGraw-Hill.
2. Andrew S. Tanenbaum, Computer Networks, Prentice Hall.
3. Keshav S. An Engineering Approach to Computer Networks, 2nd Edition, Pearson Education.

**REFERENCE BOOK**

1. William Stallings, Data and Computer Communication, Prentice Hall of India.
2. Comer, Computer Networks & Internet with Internet Applications, Pearson Education
3. Comer, Internetworking with TCP/IP, 6th Edition, PHI.
4. W Stallings, Computer Networks with Internet Protocols, Pearson Education
5. W Stallings, Local and Metropolitan Area Networks, 6th edition, Pearson Education

**BCS-326 Digital Image Processing**

| | |
|---|---|
| Course category: | Program Elective-1(PE1) |
| Pre-requisite Subject: | NIL |
| Contact hours/week: | Lecture: 3, Tutorial: 1, Practical: 0 |
| Number of Credits: | 4 |
| Course Assessment methods: | Continuous Assessment through Two Tests, Teacher Assessment (Quiz, Tutorial, Assignment, Attendance), and One Major Theory Examination. |

**Course Objective:** It contains a basic introduction to familiarize students with the basics of digital image processing. Here are the key objectives covered in this course.

1. Introduce the student to analytical tools and methods which are currently used in digital image processing as applied to image information for human viewing.
2. Then apply these tools in the laboratory in image restoration, enhancement and compression.

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

1. To understand Digital Image Processing fundamentals
2. To learn Image Transformation, Enhancement, Restoration and Compression Techniques.
3. To implement various techniques for Segmentation of Images
4. To learn the Image Reconstruction operations.
5. To implement Image Processing Techniques for suitable applications
6. To familiarize students with image enhancement and restoration techniques

**UNIT-I** **9L**

Light, Brightness Adaptation and Discrimination, Pixels, Coordinate Conventions, Imaging Geometry, Perspective Projection, Spatial domain Filtering, Sampling and quantization. Intensity Transformations, Contrast Stretching, Histogram Equalization, Correlation and Convolution, 2-D Sampling, Discrete Cosine Transform, Frequency Domain Filtering.

**UNIT-II** **9L**

Transform, Fourier Transforms and Properties, FFT (Decimation in Frequency and Decimation in Time Techniques), Basic Framework, Interactive Restoration, Image Deformation and Geometric Transformations, Image Morphing, Restoration Techniques, Noise Characterization, Noise Restoration Filters, Adaptive Filters, Linear, Position Invariant Degradations, Estimation of Degradation Functions, Restoration from Projections.

**UNIT-III** **9L**

Types of Redundancies, Lossy and Lossless Compression, Entropy af An Information Source, Shannon's Theorem, Huffman Coding, Arithmetic Coding, Golomb Coding, Bit-Plane Encoding, Bit-Allocation, Zonal Coding, Threshold Coding, Lossless Predictive Coding, Lossy Predictive Coding, Motion Compensation Expansion of Functions, Multi Resolution Analysis, Scaling Functions, Wavelet Series Expansion, Discrete Wavelet Transform (DWT), Continuous Wavelet Transform, Fast Wavelet Transform, 2-D Wavelet Transform, Digital Image Watermarking.

**UNIT-IV** **9L**

Basics of Erosion, Dilation, Opening, Closing, Hit-or-Miss Transform, Boundary Detection, Hole Filling, Connected Components, Convex Hull, Thinning, Thickening, Skeletons, Pruning, Geodesic Dilation, Erosion, Reconstruction by Dilation and Erosion. Boundary Detection Based Techniques, Point, Line Detection, Edge Detection, Edge Linking, Local Processing, Regional Processing, Hough Transform, Thresholding, Iterative Thresholding, OTSU's Method, Moving Averages, Multivariable Thresholding, Region-Based Segmentation, Watershed Algorithm, Use of Motion in Segmentation

**Textbooks:**


1. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing, Pearson, Second Edition, 2012
2. Anil K. Jain, Fundamentals of Digital Image Processing, Pearson 2012.
3. Kenneth R. Castleman, Digital Image Processing, Pearson, 2011
4. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, Digital Image Processing using MATLAB, Pearson Education, Inc., 2010.
5. William K. Pratt, Digital Image Processing, John Wiley, New York, 2012.
6. D, E. Dudgeon and R M. Mersereau, Digital Signal Processing, Prentice Hall Professional Technical Reference, 2010.
7. Milan Sonka et al, Image Processing, Analysis and Machine Vision, Brookes/Cole,


**BCS-327** **Advanced Programming Techniques**

| | |
|---|---|
| Course category: | Program Elective-1(PE1) |
| Pre-requisite Subject: | NIL |
| Contact hours/week: | Lecture: 3, Tutorial: 1, Practical: 0 |
| Number of Credits: | 4 |
| Course Assessment methods: | Continuous Assessment through Two Tests, Teacher Assessment (Quiz, Tutorial, Assignment, Attendance), and One Major Theory Examination. |

**Course Objective:** It contains a basic introduction to familiarize students with the basics of advanced programming techniques. Here are the key objectives covered in this course.

1. The focus in this course is on problem solving within the object-oriented programming paradigm
2. Read and understand software specifications to implement code that conforms to the specifications and to course coding standards.
3. Use advanced programming techniques to solve computing problems.
4. Proficiently use fundamental programming elements including: variable declaration, use of data types and simple data structures (arrays and objects), decision structures, loop structures, input and output for console and text files, and functions/methods

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

1. Develop algorithms from user problem statements.
2. Express the solutions to computer oriented problems using pseudocode.
3. Proficiently transform designs of problem solutions into a standard programming language.
4. Use an integrated programming environment to write, compile, and execute programs involving a small number of source files.
5. Apply debugging and testing techniques to locate and resolve errors, and to determine the effectiveness of a program.
6. Apply standard/structured programming techniques including design approaches, use of functions/methods, use of documentation, and avoidance of excessive branching.

**UNIT-I** **9L**

Introduction-History of Computers, Components of a Computer, Programming Languages, Compilation vs. Interpretation, Basic Program Structure and the Integrated Development Environment-Essential Program Structure, Documentation and Standard Programming Practices, Integrated Development Environment (IDE) Overview, Editing (with the IDE), Compilation (with the IDE), Execution (with the IDE), Debugging (with the IDE)

**UNIT-II** **9L**

Algorithm Development using Psuedo-code-Software Engineering Method, Procedural Problem Solving Approaches, Assignments, Conditionals, Loops, Classic Formula Problems, Classic Aggregate Problems (E.G., Maximum, Minimum, Sum, Average),
Basic Input And Output-Console Output including Basic Data Formatting, Console Input

Variables and Expressions-Variable Declarations including Common Data Types (E.G. Int, Float, String), Arithmetic, Expressions Including Precedence and Associativity, Assignment Statements (Numeric and String Data), Library Functions, Standard Programming Practices for Variables and Assignments, Case Problems Using Variables and Expressions

**UNIT-III** **9L**

Decision Structures-Boolean Expressions, Single Alternative Conditional Statements (E.G., If), Double Alternative Conditional Statements (E.G., If/Else), Multi-Way Statements (E.G., Case), Nested Conditional Structures, Standard/ Structures Programming Practices for Decision Structures, Case Problems using Decisions Structures

Loop Structures-Loop Control Variables, Initialization, Test and Modifications, Pre-Test Loop (E.G., While Loop), Post-Test Loop (E.G., Do-While Loop), Counting Loop (E.G., For Loop), Nested Loop Structures, Standard/ Structures Programming Practice for Loop Structures, Case Problems using Loop Structures

Input and Output using Files-Input Streams from Files, Priming Read Loop, Output Streams to Files, Case Problems using File Input and Output

**UNIT-IV** **9L**

Simple Data Structures-One Dimensional Arrays, Strings as Arrays, Multi-Dimensional Arrays, Records (E.G., Objects/Entities), Case Problems using Arrays and Records

Functions-Argument Passing, Returning Results, Recursion, Testing A Program System, Standard/Structures Programming Practices for Functions, Case Problems using Functions

Introduction to the Object-Oriented Approach-Class Declarations, Instance Variables, Methods, Object Instantiation, Standard/Structures Programming Practice for Classes, Case Problems using Objects

**Textbooks:**


8. Gaddis Tony, Starting Out with C++: From control structures through objects, 7th Edition, Addison-Wesley Publishing, 2012.
9. Lewis, John, and Loftus, William, JAVA Software Solutions: Foundations of Program Design, 7th Edition, Pearson, 2012.
10. Stroustrup, Bjarne, Programming: Principles and Practice Using C++, Addison-Wesley Professional, 2008


**BCS-329 Applied Graph Theory**

| | |
|---|---|
| **Course Category** | Program Elective-1 |
| **Pre-requisite Subject** | An understanding of Mathematics. |
| **Contact Hours/Week** | Lecture: 3, Tutorial: 1 & Practical: 0 |
| **Number of Credits** | 4 |
| **Course Assessment Methods** | Continuous Assessment through Two Tests, Teacher Assessment (Quiz, Tutorial, Assignment, Attendance), and One Major Theory Examination. |

**Course Objective:** The objective of this course is to introduce Graph Theory, with an emphasis on solution techniques using graphs.

**Course Outcomes:** Upon Completion of the course, the students should be able to:

1. Write precise and accurate mathematical definitions of objects in graph theory.
2. Use mathematical definitions to identify and construct examples and to distinguish examples from non-examples.
3. Validate and critically assess a mathematical proof.
4. Use a combination of theoretical knowledge and independent mathematical thinking in creative investigation of questions in graph theory.
5. Reason from definitions to construct mathematical proofs.
6. To make the students to be able to apply the abstract concepts of graph theory in modelling and solving non-trivial problems in different fields of study.

**TOPICS COVERED**

**UNIT-I** **9L**

Introduction-Discovery of graphs, Definitions, Subgraphs, Isomorphic graphs, Matrix representations of graphs, Degree of a vertex, Directed walks, paths and cycles, Connectivity in digraphs, Eulerian and Hamilton digraphs, Eulerian digraphs, Hamilton digraphs, Special graphs, Complements, Larger graphs from smaller graphs, Union, Sum, Cartesian Product, Composition, Graphic sequences, Graph theoretic model of the LAN problem, Havel-Hakimi criterion, Realization of a graphic sequence.

**UNIT-II** **9L**

Connected graphs and shortest paths – Walks, trails, paths, cycles, Connected graphs, Distance, Cut-vertices and cut-edges, Blocks, Connectivity, Weighted graphs and shortest paths, Weighted graphs, Dijkstra"s shortest path algorithm, Floyd-Warshall shortest path algorithm.

**UNIT-III** **9L**

Independent sets coverings and matchings- Introduction, Independent sets and coverings: basic equations, Matchings in bipartite graphs, Hall"s Theorem, K"onig"s Theorem, Perfect matchings in graphs, Greedy and approximation algorithms.

**UNIT-IV** **9L**

Vertex Colorings- Basic definitions, Cliques and chromatic number, Mycielski"s theorem, Greedy coloring algorithm, Coloring of chordal graphs, Brooks theorem, Edge Colorings, Introduction and Basics, Gupta-Vizing theorem, Class-1 and Class-2 graphs, Edge-coloring of bipartite graphs, Class-2 graphs, Hajos union and Class-2 graphs, A scheduling problem and equitable edge-coloring.

**TEXTBOOKS**


1. Introduction to Graph Theory, Douglas B. West, Pearson.
2. Schaums Outlines Graph Theory, Balakrishnan, TMH
3. Introduction to Graph Theory, Wilson Robin j, PHI
4. Graph Theory with Applications to Engineering And Computer Science, Narsing Deo, PHI

5. Graphs – An Introductory Approach, Wilson and Watkins

**Course Code: Microprocessors and Microcontrollers**

**BEC-305**

| | | |
|---|---|---|
| **Course category** | : | PLBSE |
| **Pre-requisite Subject** | : | NA |
| **Contact hours/week** | : | Lecture: 3, Tutorial: 1, Practical: 2 |
| **Number of Credits** | : | 5 |
| **Course Assessment methods** | : | Continuous assessment through tutorials, attendance, assignments, quizzes, practical work, record, viva voce, two minors, major theory & practical Examination |
| **Course Outcomes** | : | The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course |

1. Acquired knowledge about 8085 Microprocessor and supporting devices.
2. Ability to write the assembly language programming using 8085 microprocessor.
3. Ability to understand 8086/8088microprocessor.
4. Ability to write assembly language programming for 8086/8088.
5. Able to understand microcontroller and architecture of 8051.
6. Ability to write the assembly language programming for 8051.

**Topics Covered**

**UNIT-I**

**Introduction to Microprocessors:** Evolution of Microprocessors, Microprocessor Architecture and its operations, Memory devices, I/O Devices, **9**

**8-bit Microprocessor (8085):** Introduction, Signal Description, Register Organization, Architecture, Basic Interfacing Concepts for Memory and I/O Devices, 8085 Assembly Language Programming

**UNIT-II**

**16-bit Microprocessors (8086/8088):** Architecture, Physical address segmentation, memory 18 organization, Bus cycle, Addressing modes, difference between 8086 and 8088, Introduction to 80186 and 80286, Assembly Language Programming of 8086/8088 **9**

**UNIT-III**

**Introduction to Microcontrollers**: Microcontrollers survey, 4-bit,8-bit, 16-bit, 32-bit **9**

Microcontrollers, Comparing Microprocessors and Microcontrollers, Overview of the 8051 Microcontroller family.

**8051 Architecture:** Hardware, Oscillator and clock-program counter, data pointer registers, stack and stack pointer, special function registers, memory organization, program memory, data memory, Input/Output Ports, External memory counter and timer, serial data Input/output Interrupts.

**UNIT-IV** **9**

**8051 Assembly Language Programming**: Structure of Assembly language, Assembling and running an 8051 program, addressing modes, Accessing memory using various addressing modes

**Instruction set:** Arithmetic operations and Programs, Logical operations and Programs, Jump and Call instructions and Programs, Input/Output Programs, Single bit instructions and Programs, Timer, counter and Programs.

**LIST OF EXPERIMENTS**

1. Write a program for Decimal addition and subtraction of two numbers.
2. Write a program for Hexadecimal addition and subtraction of two numbers.
3. Write a program for addition and subtraction of two BCD numbers.
4. To perform multiplication and division of two 8 bit numbers.
5. To find the largest and smallest number in an array of data.
6. To write a program to arrange an array of data in ascending order.
7. To write a program to arrange an array of data in descending order.
8. To convert given Hexadecimal number into its equivalent ASCII number and vice versa using 8085 instruction set.

**Text/Reference Books**


1. R. Singh and B. P. Singh: Microprocessor Interfacing and Application, New Age International Publishers, 2nd Edition.
2. D. V. Hall: Microprocessors Interfacing, TMH (2nd Edition).
3. R. S. Gaunkar: Microprocessor Architecture, Programming and Applications with 8085/8080, Penram Publication
4. Y.C. Liu and G.A. Gibson: Microcomputer Systems: The 8086/8088 Family Architecture Programming and Design, PHI 2nd Edition,
5. The 8051 Microcontrollers and Embedded Systems: Muhammed Ali Mazidi, 2nd edition, Pearson Education India.

6. The 8051 Microcontrollers Architecture, Programming & Applications Kenneth J. Ayala

**SCS-312 Computational Data analytics**

| | | |
|---|---|---|
| Course Category | : | Data Science (DM) |
| 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, viva voce, minor tests, and major theory examination. |

**Course Objective:** It is our goal that students will develop the skills needed to become a practitioner or carry out applied research and development projects in the domain of computational data science.

**Course Outcomes:**

After completion of course, students would be able to:

1. Describe how data is collected, managed, and stored for data science.
2. How to use different Machine learning model.
3. Analyse various ML algorithms on data models.
4. How to think about study system and research question of interest in a systematic way to design an efficient sampling and experimental research program.
5. How to analyse collected data to derive the most information possible about research questions.
6. Select and evaluate data structures and caching approaches for on-demand computation of analytics

**Course Contents:**

**Unit 1:**

R Computing language. Best practices in executing Reproducible Research in data science, Sampling and Simulation. Descriptive statistics, good observational sampling designs creation

**Unit 2:**

Data import and visualization, Introduction to various plots

**Unit 3:**

Frequentist Hypothesis Testing, Z-Tests, Power Analysis

**Unit 4:**

Linear regression, diagnostics, visualization, Likelihoodist Inference, Fitting a line with Likelihood, Model Selection with one predictor

**Unit 5:**

Bayesian Inference, Fitting a line with Bayesian techniques, Multiple Regression and Interaction Effects, Information Theoretic Approaches

**Lab Work:**

1. To provide a basic insight of R and its libraries.
2. R as a Data Importing Tool, Dplyr. Forcats.
3. Simulation and Frequentist Hypothesis testing, Simulation and Power.
4. Bayesian computation in R, Fitting a line with Bayesian techniques.

**Textbooks/References:**


1. Practical Data Science with R, Nina Zumel, John Wiley & Sons.
2. N. C. Das, Experimental Designs in Data Science with Least Resources, Shroff Publisher Publisher.
3. Hadley Wickham, Garret Grolemund, *R for Data Science*, Shroff Publisher/O'Reilly Publisher Publisher
4. Benjamin M. Bolker. *Ecological Models and Data in R*. Princeton University Press, 2008. ISBN 978-0-691-12522-0.
5. John Fox and Sanford Weisberg. *An R Companion to Applied Regression*. Sage Publications, Thousand Oaks, CA, USA, second edition, 2011. ISBN 978-1-4129-7514-


**SCS-322 Ubiquitous Sensing, Computing and Communication**

| | | |
|---|---|---|
| Course Category | : | Internet of Things (DM) |
| 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, viva voce, minor tests, and major theory examination. |

**Course Objective:** The goal of this course is to acquaint participants with some of the fundamental concepts and state-of-the-art research in the areas of ubiquitous computing. Since

this field is rapidly progressing, the course is aimed at students who want to explore it as researchers or track its evolution.

**Course Outcomes:**

After completion of course, students would be able:

1. To understand merging technological options, platforms, and case studies of IoT implementation in home & city automation.
2. To determine the Market perspective of IoT.
3. Basic introduction of all the elements of IoT-Mechanical, Electronics/sensor platform, Wireless and wireline protocols, Mobile to Electronics integration, Mobile to enterprise integration.
4. To understand basics of open source/commercial electronics platform for IoT.
5. To understand basics of open source /commercial enterprise cloud platform for IoT.
6. To explore the high level facilities, system architecture and protocols of the ubiquitous system and apply data analytics to facilitate next generation computing.

**Course Contents:**

**Unit 1**

Introduction, Overview, Challenges in IoT, Networking Basics of IoT, NFC, Wireless LAN. 54

**Unit 2**

Location in ubiquitous computing: Personal assistants, Location aware computing, Location tracking, Architecture, Location based service and applications, Location based social networks (LBSN), LBSN Recommendation. Context-aware computing: Context and Context-aware Computing, Issues and Challenges, Developing Context-aware Applications, System Architecture.

**Unit 3**

Privacy and security in ubiquitous computing, Energy constraints in ubiquitous computing.
Wearable computing, Glass and Augmented Reality, Eye-Tracking, Digital Pen and Paper, Mobile social networking & crowd sensing, Event based social network.

**Unit 4**

Mobile affective computing: Human Activity and Emotion Sensing, Health Apps, Mobile p2p computing, Smart Homes and Intelligent Buildings, Mobile HCI, Cloud centric IoT, Open challenges, Architecture, Energy Efficiency, Participatory sensing, Protocols, QoS, QoE.

**Unit 5**

IoT and data analytics IoT and Data Management, Data cleaning and processing, Data storage models.
Search techniques, Deep Web, Semantic sensor web, Semantic Web Data Management, Searching in IoT.

Real-time and Big Data Analytics for The Internet of Things, Heterogeneous Data Processing, High-dimensional Data Processing, Parallel and Distributed Data Processing.

**Textbooks/References:**


1. N. Jeyanthi, Ajith Abraham, Hamid Mcheick, "Ubiquitous Computing and Computing Security of IoT".
2. John Krumm, Ubiquitous Computing Fundamentals, CRC Press.
3. Dirk Slama, "Enterprise IoT", Shroff Publisher/O'Reilly Publisher


**SCS-232 Concepts of Virtual and Augmented Reality**

| | | |
|---|---|---|
| Course Category | : | Virtual and Augmented Reality(DM) |
| 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, viva voce, minor tests, and major theory examination. |

**Course Objective:** This course is designed to give historical and modern overviews and perspectives on virtual reality. It describes the fundamentals of sensation, perception, technical and engineering aspects of virtual reality systems.

**Course Outcomes:**

After completion of course, students would be able:

1. To analyse the hardware and software requirements.
2. To use the different intersection techniques.
3. To design 3D interfaces.
4. To understand the basic concept and framework of virtual reality.
5. To understand the principles and multidisciplinary features of virtual reality.
6. To understand the technology for multimodal user interaction and perception in VR, the visual, audial, and haptic interface and behaviour.

**Course Contents:**

**Unit 1**

Virtual reality and virtual environments: the historical development of VR, scientific landmarks computer graphics, real-time computer graphics, virtual environments, requirements for VR, benefits of virtual reality.
Hardware technologies for 3D user interfaces: visual displays, auditory displays, haptic displays, choosing output devices for 3D user interfaces.

**Unit 2**

3D user interface input hardware: input device characteristics, desktop input devices, tracking devices, 3d mice, special purpose input devices, direct human input, home - brewed input devices, choosing input devices for 3D interfaces.
Software technologies: database - world space, world coordinate, world environment, objects - geometry, position / orientation, hierarchy, bounding volume, scripts and other attributes, VR environment - VR database, tessellated data, LODs, Cullers and Occluders, lights and cameras, scripts, interaction - simple, feedback, graphical user interface, control panel, 2D controls, hardware controls, room / stage / area descriptions, world authoring and playback, VR toolkits, available software in the market.

**Unit 3**

3D interaction techniques: 3D manipulation tasks, manipulation techniques and input devices, interaction techniques for 3D manipulation, design guidelines – 3D travel tasks, travel techniques, design guidelines - theoretical foundations of wayfinding, user centered wayfinding support, environment centered wayfinding support, evaluating wayfinding aids, design guidelines - system control, classification, graphical menus, voice commands, Gestrual commands, tools, mutimodal system control techniques, design guidelines, case study: mixing system control methods, symbolic input tasks, symbolic input techniques, design guidelines, beyond text and number entry.

**Unit 4**

Designing and developing 3D user interfaces: strategies for designing and developing guidelines and evaluation.
Advances in 3D user interfaces: 3D user interfaces for the real world, AR interfaces as 3D data browsers, 3D augmented reality interfaces, augmented surfaces and tangible interfaces, agents in AR, transitional AR-VR interfaces - the future of 3D user interfaces, questions of 3D UI technology, 3d interaction techniques, 3d UI design and development, 3D UI evaluation and other issues.

**Unit 5**

Virtual reality applications: engineering, architecture, education, medicine, entertainment, science, training.

**Textbooks/References:**


1. Paul Mealy, Virtual & Augmented Reality for Dummies, John Wiley & Sons.
2. Alan B Craig, William R Sherman and Jeffrey D Will, “Developing Virtual Reality Applications: Foundations of Effective Design”, Morgan Kaufmann.
3. Jan Erik Solem, Programming Computer Vision with Python, Shroff Publisher/O’Reilly Publisher
4. Gerard Jounghyun Kim, “Designing Virtual Systems: The Structured Approach”.
5. Doug A Bowman, Ernest Kuijff, Joseph J LaViola, Jr and Ivan Poupyrev, “3D User Interfaces, Theory and Practice”, Addison Wesley, USA

**BHM-354** **BUSINESS MANAGEMENT**

| | | |
|---|---|---|
| **Course category** | : | M |
| **Pre-requisite Subject** | : | NIL |
| **Contact hours/week** | : | Lecture: 2, Tutorial: 0, Practical: 0 |
| **Number of Credits** | : | 2 |
| **Course Assessment methods** | : | Continuous assessment through tutorials, attendance, home assignments, quizzes, two minor tests, and one major theory examination. |
| **Course Objectives** | : | To help the students gain understanding of the functions and responsibilities of managers and provide them tools and techniques to be used in the performance of the managerial job so that they can be to analyze and understand the environment of the organization and importance of management principles. |

**Course Outcome:**

1. Students will comprehend and correlate all the fundamental Management functions and the concepts and principles of Management.
2. Demonstrate Engineering students, demonstrate the roles, skills, and functions of Management.
3. Students will develop Interdisciplinary skills which can help them to thrive in the life-long changing environment in various fields of business.
4. One can analyze the effective application of management knowledge principles and practices to diagnose and solve organizational problems and develop optimal managerial decisions.
5. Demonstrate the acumen in organizing and understanding the staffing process.
6. Understand the complexities associated with management in the organizations and integrate the learning in handling these complexities

**Topics Covered**

**UNIT-I** **6**

Meaning and Definition, Need for business, Nature of Business, Scope, Objectives, Qualities of a Successful Businessman. Forms of Business Ownership, Public, Private, and Joint Sector Undertaking, Public-Private Partnership, NGO – only meaning.

**UNIT-II** **6**

Meaning, Emergence of Management Thought, Characteristics of Management, Bureaucracy, Scientific Management, Administrative Theories of Management, Principles of Management, Social Responsibility of Management, and Business Ethics.

**UNIT-III** 6

Meaning & Definition, Characteristics of a Good Plan, Planning Process, Types of Plans, MBO &MBE, Decision making: Types of Decisions, Steps involved in Decision Making, Communication, Importance of Communication and Types of Communication.

**UNIT-IV** 6

Meaning, characteristics, the importance of organization, steps in organization, organization structure, departmentation–meaning and basis for departmentation. The span of management-Meaning Only, Centralization vs. Decentralization, Definition, Staffing-Meaning, Functions, Selection Procedure and Instruments used in the selection.

**Text and Reference Books**


1. Business Management, Dr. P. Subba Rao, Roopa Traisa, Himalaya Publishing.
2. Management, Michael A Hitt, J Stewart Black, Lyman W - Prentice-Hall publishing – 2nd Revised edition.
3. Essentials of management, Harold Koontz Heinz Weihrich - Tata Mc Graw hill publishing.
4. Business management, R. K Sharma, Shashi K. Gupta – Kalyani publishers – 2009.
5. Business management, Appanniah Reddy - Himalaya publishers.2008.


**BCS-351 ARTIFICIAL INTELLIGENCE**

**Course Category**: Department Core (DC)

**Pre-requisite Subject** : NIL

**Contact Hours/Week**: Lecture: 3, Tutorial: 1, Practical: 2.

**Number of Credits**: 5

**Course Assessment Methods**: Continuous Assessment through Two Tests, Teacher Assessment (Quiz, Tutorial, Assignment, Attendance), Practical Work & Viva-voce, and One Major Theory & One Practical Examinations.

**Course Objective:** This course introduces the fundamentals of artificial intelligence. It contains a theory component about the concepts and principles that underlie modern AI algorithms, and a practice component to relate theoretical principles with practical implementation.

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

1. The intelligent agents—software or hardware entities that perform useful tasks with some degree of autonomy.

2. An understanding of the basic areas of artificial intelligence including problem solving, knowledge representation, reasoning, decision making, planning, perception and action, and learning -- and their applications (e.g., data mining, information retrieval)
3. Design and implement key components of intelligent agents of moderate complexity in JAVA and /or Lisp or Prolog and evaluate their performance.
4. Develop familiarity with current research problems, research methods, and the research literature in Al
5. Knowledge and application of basic principles and techniques of intelligent systems and their practical applications.
6. Formalization and design of systems capable of automated reasoning.

**Topics Covered**

**UNIT-I**

Artificial Intelligence Introduction, Intelligent Agents, Solving Problems by Searching Beyond Classical Search Adversarial Search Constraint Satisfaction Problems. (9)

**UNIT-II**

Knowledge and Reasoning, Logical Agents, First-Order Logic Inference in First-Order Logic, Classical Planning and Acting in the Real-World Knowledge Representation Uncertain Knowledge and Reasoning Quantifying Uncertainty Probabilistic Reasoning Probabilistic Reasoning over Time Making Simple Decisions Making Complex Decisions. (9)

**UNIT-Ill**

Planning and Acting in the Real-World Definition of Classical Planning Algorithms for Planning as State-Space Search Planning Graphs Classical planning as Boolean Satisfiability, representing temporal and resource constraints Planning and Acting in Nondeterministic Domains. Introduction to Genetic algorithm and its various applications. Knowledge Representation Acting under Uncertainty Probabilistic Reasoning Time and Uncertainty Learning from Examples Knowledge in Learning Probabilistic Models Reinforcement Learning, Hidden Markov Models (HMM). (9)

**UNIT- IV**

Forms of Learning Supervised Learning, Decision Trees Evaluating and Choosing the Best Hypothesis. Introduction to Fuzzy Logic and its various applications. A Logical Formulation of Learning Statistical Learning, Naive Bayes models, learning with hidden data EM algorithm, Learning with complete data with Complete Data Natural Language Processing Communicating, Perceiving, and Acting Natural Language Processing Natural Language for Communication Perception Robotics. (9)

**EXPERIMENTS**

1. Write the program to solve the water jug problem using production rule set.
2. Write the program to solve the water jug problem using A* ALGORITHM.
3. Write the program to solve the 8-puzzle problem using A* ALGORITHM.
4. Write the program to solve the salesman problem using A* ALGORITHM.
5. Write the program to solve the farmer transfer three belonging form one side of the river to other side using AO* ALGORITHM.
6. Write the program to solve the DISEASE problem using Bayesian reasoning.
7. Write the program to solve the Object finding problem using Bayesian reasoning.
8. Write the program to solve the Object finding problem using D S theory.
9. Write the program to solve the Decision Trees Evaluating.
10. Write the program for walk, drive, take the bus, take a cab, and fly problem using mean end analysis.

**Textbooks**

1. S. Russel and P. Norvig, "Artificial Intelligence — A Modern Approach", Second Edition, Pearson Education, 2012.

**Reference books**

2. David Poole, Alan Mackworth, Randy Goebel, Computational Intelligence: a logical approach, Oxford University Press, 2012.
3. G. Luger, "Artificial Intelligence: Structures and Strategies for complex problem solving", Fourth Edition, Pearson Education, 2012.
4. 1. Nilsson, "Artificial Intelligence: A new Synthesis", Elsevier Publishers, 1998.

**BCS-352 Software Engineering**

| | |
|---|---|
| Course category: | Program Core Course (PC) |
| Pre-requisite Subject: | NIL |
| Contact hours/week: | Lecture: 3, Tutorial: 1, Practical: 0 |
| Number of Credits: | 4 |
| Course Assessment methods: | Continuous Assessment through Two Tests, Teacher Assessment (Quiz, Tutorial, Assignment, Attendance), and One Major Theory Examination. |

**Course Objective:** It contains a basic introduction to familiarize students with the basics of software Engineering. Here are the key objectives covered in this course

1. The aim of the course is to provide an understanding of the working knowledge of the techniques for estimation, design, testing and quality management of large software development projects.

2. Topics include process models, software requirements, software design, software testing, software process/product metrics, risk management, quality management and UML diagrams

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

1. List and describe the fundamental phases of the Software Development Life cycle (SDLC)
2. Define and describe fundamental software engineering terminology and coding practices
3. Explore/explain relationships between software engineering and other engineering disciplines (Systems Engineering, Electrical and Computer Engineering, Industrial Engineering)
4. Modify/build a software program that introduces students to software development tools / environments
5. Troubleshoot and debug changes made to an existing software program
6. Build a foundation for academic success in the Software Engineering degree program

**UNIT-I** **6L**

Software Process – Introduction, S/W Engineering Paradigm, Life Cycle Models (Waterfall, Incremental, Spiral, Evolutionary, Prototyping), Software Requirements –Functional And Non-Functional – Software Document – Requirement Engineering Process – Feasibility Studies – Software Prototyping – Prototyping in Software, Process – Data – Functional and Behavioral Models – Structured Analysis And Data Dictionary.

**UNIT-II** **6L**

Basic Concept of Software Design, Architectural Design, Low Level Design: Modularization, Design Structure Charts, Pseudo Codes, Flow Charts, Coupling and Cohesion Measures, Design Strategies: Function Oriented Design, Object Oriented Design, Top-Down and Bottom-Up Design. Software Measurement and Metrics: Various Size Oriented Measures: Halestead's Software Science, Function Point (FP) Based Measures, Cyclomatic Complexity Measures: Control Flow Graph.

**UNIT-III** **6L**

Software Testing – Taxonomy of S/W Testing Levels - Black Box Testing – Testing Boundary Conditions – Structural Testing — Regression Testing– S/W Testing Strategies, Unit Testing, Integration Testing, Validation Testing, System Testing and Debugging.

**UNIT-IV** **6L**

Measures and Measurements – Zipf's Law, Software Cost Estimation – Function Point Models, COCOMO Model. Delphi Method – Scheduling – Earned Value Analysis – Error Tracking – Software Configuration Management – Program Evolution Dynamics – Software Maintenance – Project Planning – Project Scheduling– Risk Management – Case Tools

**Textbooks:**

11. R. S. Pressman, "Software Engineering - A practitioners approach", 3rd Edition, McGraw Hill International editions, 1992.
12. IAN Sommerville, Software Engineering, Pearson Education Asia, VI Edition, 2000
13. Pankaj Jalote, "An Integrated Approach to software Engineering", Springer Verlag, 1997

**BCS-353 Parallel and Distributed Programming**

| | |
|---|---|
| **Course Category** | PC |
| **Pre-requisite Subject** | NIL |
| **Contact Hours/Week** | Lecture: 3, Tutorial: 0 & Practical: 2 |
| **Number of Credits** | 4 |
| **Course Assessment Methods** | Continuous Assessment through Two Tests, Teacher Assessment (Quiz, Tutorial, Assignment, Attendance), Practical Work & Viva-voce, and One Major Theory & One Practical Examinations. |

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**Course Objective:** This course helps the students in gaining the knowledge to basic principle of parallel and distributed systems. This course helps to undertake future courses that assume as a background in management of system resources.

1. Discuss basic theory and practice of Parallel and Distributed algorithms
2. Design and implement new Parallel and Distributed algorithms

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

1. Understand and account for models, limitations, and fundamental concepts in message passing and shared memory concurrency, and apply this understanding to example systems and algorithms
2. Adapt, and design algorithms for execution in parallel and distributed settings, and analyze the algorithms for correctness, reliability, security, and performance
3. Develop and apply knowledge of parallel and distributed computing techniques and methodologies
4. Apply design, development, and performance analysis of parallel and distributed applications
5. Use the application of fundamental Computer Science methods and algorithms in the development of parallel applications.
6. Explain the design, testing, and performance analysis of a software system, and to be able to communicate that design to others.

**TOPIC COVERED**

**UNIT-I 9L**

Parallel Computing, Parallel Computer Model, Parallel Architectural Classification Schemes, Multiprocessor System and Interconnection Networks. Theoretical Foundation for Distributed System: Limitation of Distributed System, Absence of Global Clock, Shared Memory, Logical

Clocks, Lamport's & Vectors Logical Clocks, Causal Ordering of Messages, Global State, Termination Detection.

.

**UNIT-II** **9L**

Distributed Mutual Exclusion: Classification of Distributed Mutual Exclusion, Requirement of Mutual Exclusion Theorem, Token Based and Non-Token Based Algorithms, Performance Metric for Distributed Mutual Exclusion Algorithms

**UNIT-III** **9L**

Distributed Deadlock Detection: System Model, Resource vs Communication Deadlocks, Deadlock Prevention, Avoidance, Detection & Resolution, Centralized Dead Lock Detection, Distributed Dead Lock Detection, Path Pushing Algorithms, Edge Chasing Algorithms. Agreement Protocols: Introduction, System Models, Classification of Agreement Problem, Byzantine Agreement Problem, Consensus Problem, Interactive Consistency Problem, Solution to Byzantine Agreement Problem, Application of Agreement Problem

**UNIT-IV** **9L**

Distributed File Systems: File Service Architecture, Sun Network File System, The Andrew File System, Recent Advances.

Distributed Algorithms: Introduction to Communication Protocols, Balanced Sliding Window Protocol, Routing Algorithms, Destination Based Routing, APP Problem, Deadlock Free Packet Switching, Introduction to Wave & Traversal Algorithms, Election Algorithm, CORBA Case Study: CORBA RMI, CORBA Services

**EXPERIMENTS**

1. Write a program to simulate the functioning of Lamport's logical clock in C.
2. Write a program to simulate the Distributed Mutual Exclusion in C.
3. Write a program to implement a Distributed chat server using TCP sockets in C.
4. Implement RPC mechanism for a file transfer across a network in C".
5. Write a JAVA code to implement JAVA RMI mechanism for accessing methods of remote systems.
6. Write a code in C to implement sliding window protocol.
7. Implement COBRA mechanism by using C++ program at one end and JAVA program at the other.
8. Write a code in C to Increment a counter in shared memory

**TEXTBOOKS**

1. Singhal Mukesh & Shivaratri N. G., Advanced Concepts in Operating Systems, TMH

**REFERENCE BOOKS**

1. D. Culler, J. P. Singh, A. Gupta, Parallel Computer Architecture, Elsevier
2. Andrew S. Tanenbaum and Maarten Van Steen, Distributed Systems Principles and Paradigms, PHI

3. Tanenbaum, A. S. Distributed Operating Systems, Prentice Hall
4. Tanenbaum, A. S., Modern Operating Systems, 2nd Edition, Prentice Hall, 2001
5. Bacon, J., Concurrent Systems, 2nd Edition, Addison Wesley 1998
6. Coulouris, G. et al, Distributed Systems: Concepts and Design, 3rd Edition, Addison Wesley
7. Galli, D.L., Distributed Operating Systems: Concepts and Practice, Prentice-Hall

**BCS-376 Analytics and Systems of Big Data**

| | |
|---|---|
| Course category: | Program Elective-2(PE2) |
| Pre-requisite Subject: | NIL |
| Contact hours/week: | Lecture: 3, Tutorial: 1, Practical: 0 |
| Number of Credits: | 4 |
| Course Assessment methods: | Continuous Assessment through Two Tests, Teacher Assessment (Quiz, Tutorial, Assignment, Attendance), and One Major Theory Examination. |

**Course Objective:** It contains a basic introduction to familiarize students with the basics of big data concepts. Here are the key objectives covered in this course.

1. To provide a basic introduction to big data and corresponding quantitative research methods.
2. To familiarize students with big data analysis as a tool for addressing substantive research questions. The course begins with a basic introduction to big data and discusses what the analysis of these data entails, as well as associated technical, conceptual and ethical challenges.

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

1. Demonstrate the knowledge of big data, data science, data analytics, distributed file systems, parallel MapReduce paradigm, NoSQL, machine learning, etc
2. Program and implement examples of big data and NoSQL applications using
3. open-source Hadoop, HDFS, MapReduce, Hive, Pig, Mahout, etc
4. Read current research papers and implement example research group project in big data
5. Attaining a basic understanding of what big data analysis entails
6. To study different types of Case studies on the current research and applications of the Hadoop and big data in industry

**UNIT-I 9L**

Big Data, Complexity of Big Data, Big Data Processing Architectures, Big Data Technologies, Big Data Business Value, Data Warehouse, Re-Engineering the Data Warehouse, Workload Management in the Data Warehouse, New Technology Approaches.

Integration of Big Data and Data Warehouse, Data Driven Architecture, Information Management and Lifecycle, Big Data Analytics, Visualization and Data Scientist, Implementing the "Big Data" Data. Choices in Setting Up R for Business Analytics, R Interfaces, Manipulating Data, Exploring Data, Building Regression Models, Clustering and Data Segmentation, Forecasting and Time Series Models

**UNIT-II** **9L**

Writing Hadoop Map Reduce Programs, Integrating R and Hadoop, Using Hadoop Streaming with R, Learning Data Analytics with R and Hadoop, Understanding Big Data Analysis with Machine Learning. Big Data, Web Data, A Cross-Section of Big Data Sources and the Value They Hold, Taming Big Data, The Evolution of Analytic Scalability.

**UNIT-III** **9L**

The Evolution of Analytic Processes, The Evolution of Analytic, Processes the Evolution of Analytic Tools and Methods. Legacy Data, Hypothesis Testing, Prediction, Software, Complexity, Business problems suited to Big Data Analytics.

**UNIT-IV** **9L**

High Performance Appliances for Big Data Management using Graph Analytics, The New Information Management Paradigm, Big Data's Implication for Businesses, Big Data Implications for Information Management, Splunk's Basic Operations on Big Data.

**Textbooks:**


1. Anand Rajaraman, Jure Leskovec, and Jeffrey D. Ullman,Mining of Massive Data Sets,Cambridge University Press. 2011.
2. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer, 2007.
3. Viktor Mayer Schönberger, Kenneth Cukier, Big Data: A Revolution That Will Transform How We Live, Work, and Think, John Murray 2013


**BCS-377** **Introduction to Machine Learning**

| | |
|---|---|
| Course category: | Program Elective-2 (PE2) |
| Pre-requisite Subject: | NIL |
| Contact hours/week: | Lecture: 3, Tutorial: 1, Practical: 0 |
| Number of Credits: | 4 |
| Course Assessment methods: | Continuous Assessment through Two Tests, Teacher Assessment (Quiz, Tutorial, Assignment, Attendance), and One Major Theory Examination. |

**Course Objective:** It contains a basic introduction to familiarize students with the basics of machine learning. Here are the key objectives covered in this course.

1. Students understand issues and challenges of Machine Learning.
2. Should be able to select data, model selection, model complexity etc.
3. Understanding of the strengths and weaknesses of many popular machine learning approaches

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

1. To explain theory underlying machine learning

2. To construct algorithms to learn linear and non-linear models
3. To implement data clustering algorithms
4. To construct algorithms to learn tree and rule-based models
5. To apply reinforcement learning techniques
6. Apply the algorithms to a real problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models

**UNIT-I** **9L**

**FOUNDATIONS OF LEARNING-** Components of Learning – Learning Models – Geometric Models – Probabilistic Models – Logic Models – Grouping and Grading – Learning Versus Design – Types of Learning – Supervised – Unsupervised – Reinforcement – Theory of Learning – Feasibility of Learning – Error and Noise – Training versus Testing – Theory of Generalization – Generalization Bound – Approximation- Generalization Tradeoff – Bias and Variance – Learning Curve

**UNIT-II** **9L**

**LINEAR MODELS-**Linear Classification – Univariate Linear Regression – Multivariate Linear Regression – Regularized Regression – Logistic Regression – Perceptron – Multilayer Neural Networks – Learning Neural Networks Structures – Support Vector Machines – Soft Margin SVM – Going Beyond Linearity – Generalization and Over Fitting – Regularization – Validation

**UNIT-III** **9L**

**DISTANCE-BASED MODELS-**Nearest Neighbour Models – K-Means – Clustering around Medoids – Silhouettes – Hierarchical Clustering – K-D Trees – Locality Sensitive Hashing – Non-Parametric Regression – Ensemble Learning – Bagging And Random Forests – Boosting – Meta Learning

**UNIT-IV** **9L**

**TREE AND RULE MODELS-** Decision Trees – Learning Decision Trees – Ranking and Probability Estimation Trees – Regression Trees – Clustering Trees – Learning Ordered Rule Lists – Learning Unordered Rule Lists – Descriptive Rule Learning – Association Rule Mining – First-Order Rule Learning

**REINFORCEMENT LEARNING-**Passive Reinforcement Learning – Direct Utility Estimation – Adaptive Dynamic Programming – Temporal-Difference Learning – Active Reinforcement Learning – Exploration – Learning an Action-Utility Function – Generalization in Reinforcement Learning – Policy Search – Applications in Game Playing – Applications in Robot Control

**Textbooks:**


14. EthemAlpaydın -Introduction to Machine Learning Third Edition, MIT Press, 2004
15. P. Flach, Machine Learning: The art and science of algorithms that make sense of data, Cambridge University Press, 2012.
16. Y. S. Abu-Mostafa, M.Magdon-Ismail, and H.-T. Lin, Learning from Data, AMLBook Publishers, 2012

17. M. Mohri, A. Rostamizadeh, and A. Talwalkar, Foundations of Machine Learning, MIT Press, 2012.

**BCS-378 Embedded System**

| | |
|---|---|
| **Course Category** | Program 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 Two Tests, Teacher Assessment (Quiz, Tutorial, Assignment, Attendance), and One Major Theory Examination. |

**Course Objective:** The objective of this course is to introduce Embedded System, with an emphasis on solution techniques using embedded system.

1. Ability to adapt the emerging embedded system technologies for designing and prototyping
2. learning recent technologies as Internet of Things (IoT) and Mobile Communication to provide technical solutions to societal needs.
3. Develop hardware, and firmware for automated solutions to solve Industrial problems

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

1. Basics of Micro-processors and Micro-controller.
2. Analyse the concepts and configuration of memory and processors.
3. Programming of Micro-processors and Micro-controllers.
4. In building things like Robots and real time embedded systems.
5. To become familiar with the embedded computing platform design and analysis.
6. To get thorough knowledge in interfacing concepts

**TOPICS COVERED**

**UNIT-I** **9L**

**Introduction to Embedded Systems**: Definition of Embedded System, Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems.

**UNIT-II** **9L**

**Typical Embedded System**: Core of the Embedded System: General Purpose and Domain Specific Processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS), Memory: ROM, RAM, Memory according to the type of Interface, Memory Shadowing, Memory selection for Embedded Systems, Sensors and Actuators, Communication Interface: Onboard and External Communication Interfaces.

**UNIT-III** **9L**

**Embedded Firmware**: Reset Circuit, Brown-out Protection Circuit, Oscillator Unit, Real Time Clock, Watchdog Timer, Embedded Firmware Design Approaches and Development Languages.

**RTOS Based Embedded System Design**: Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling.

UNIT-IV **9L**

Task Communication: Shared Memory, Message Passing, Remote Procedure Call and Sockets, Task Synchronization: Task Communication Synchronization Issues, Task Synchronization Techniques, Device Drivers, How to Choose an RTOS. Embedded Processor Architecture, Overview of Microcontroller and Embedded Systems, Microcontroller fundamentals for basic programming, Embedded communications protocols and Internet of Things

**TEXTBOOKS**


1. Embedded Systems – Raj Kamal, TMH.
2. Embedded System Design – Frank Vahid, Tony Givargis, John Wiley.
3. Embedded Systems – Lyla, Pearson, 2013

An Embedded Software Primer – David E. Simon, Pea


**BCS- 379** **COMPUTATIONAL COMPLEXITY**

| | |
|---|---|
| **Course Category** | Program Elective (PE) |
| **Pre-requisite Subject** | Design and Analysis of Algorithms, Theory of Computations |
| **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 Two Minor tests and One Major Theory Examination |

**Course Objective:** This course helps the students in gaining the knowledge of the theory of computational complexity and standard complexity classes. The principal objectives of this course are:

1. To provide the knowledge of computational problems and the related difficulties to solve.
2. To classify the computational problems according to how difficult they are to solve and many more are impractical to solve in a reasonable amount of time.
3. To identify a rigorous model of computation and a means of comparing problems of different kinds

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

1. Classify decision problems into appropriate complexity classes, including P, NP, PSPACE and complexity classes based on randomised machine models and use this information effectively.

2. State precisely what it means to reduce one problem to another, and construct reductions for simple examples.
3. Classify optimisation problems into appropriate approximation complexity classes and use this information effectively.
4. Use the concept of interactive proofs in the analysis of optimisation problems.
5. Classify optimisation problems into appropriate approximation complexity classes and use this information effectively.
6. Use the concept of interactive proofs in the analysis of optimisation problems.

**Topics Covered**

**UNIT-I** **9L**

Introduction to the course, Polynomial time reductions, P and NP classes, Review of NP Completeness, P vs NP, NP Complete problems, Cook-Levin Theorem, Polynomial Hierarchy, Time, Hierarchy Theorem, Space Complexity, Savitch's Theorem, NL-Completeness, NL = coNL

**UNIT-II** **9L**

PSPACE Completeness, Space Hierarchy Theorem, Ladner Theorem, Oracles, Baker-Gill-Solovay Theorem, Randomized Complexity Classes, Randomized Complexity Classes(contd.), BPP is in polynomial hierarchy, Circuit Complexity, Circuit Hierarchy Theorem.

**UNIT-III** **9L**

P/poly complexity class, NC and AC classes, Karp-Lipton Theorem, Parity not in AC^0, Adleman's Theorem, Polynomial Identity Testing, Perfect Matching is in RNC^2, Bipartite Perfect Matching is in RNC (contd.), Isolation Lemma, Valiant Vazirani Theorem, #P and #P Completeness.

**UNIT-IV** **9L**

Permanent is #P Complete, Toda's Theorem, Communication Complexity, Lower bound techniques, Monotone depth lower bound for matching, Introduction to Interactive Proofs, #3-SAT is in IP, Private and Public Coin Interactive proofs.

**Textbooks**


7. Sanjeev Arora and Boaz Barak, *Computational Complexity: A Modern Approach*; Cambridge; 2009. ISBN: 9780521424264
8. Christos H Papadimitriou, Computational complexity, Addison-Wesley, 1994.
9. Bernard M E Moret, The Theory of Computation, Addison-Wesley, 1998


**Reference books**


3. Avi Wigderson, Mathematics and Computation: A Theory Revolutionizing Technology and Science; Princeton University Press; 2019. ISBN: 9780691192543.


SCS-313 Web Data Mining

| | | |
|---|---|---|
| Course Category | : | DM |
| Pre-requisite Subject | : | NIL |
| Contact Hours/Week | : | Lecture: 3, Tutorial: 0, Practical: 0 |
| Number of Credits | : | 3 |
| Course Assessment Methods | : | Continuous assessment through tutorials, attendance, home assignments, quizzes, viva voce, minor tests, and major theory examination. |

Course Objective:

1. To learn how to extract data from the Web.
2. To understand how to analyze collected data to derive the most information

Course Outcomes: After completion of course, students would be able:

1. To explain how data can be collected from the Web.
2. To extract data and information from the webpages.
3. To make decision based on the data collected.
4. To know different data security and privacy threats.
5. To explain how data can be preprocessed.
6. To explain different web mining tools.

TOPIC COVERED

UNIT-I 9

Introduction to internet and WWW, Data Mining Foundations, Association Rules and Sequential Patterns, Basic Concepts of Association Rules, Apriori Algorithm, Frequent Itemset Generation, Association Rule Generation, Data Formats for Association Rule Mining, Mining with multiple minimum supports, Extended Model, Mining Algorithm, Rule Generation, Mining Class Association Rules, Basic Concepts of Sequential Patterns, Mining Sequential Patterns on GSP, Mining Sequential Patterns on Prefix Span, Generating Rules from Sequential Patterns.

UNIT-II 9

Concepts of Information Retrieval, IR Methods, Boolean Model, Vector Space Model and Statistical Language Model, Relevance Feedback, Evaluation Measures, Text and Web Page Pre-processing, Stopword Removal, Stemming, Web Page Preprocessing, Duplicate Detection, Inverted Index and Its Compression, Inverted Index, Search using Inverted Index, Index Construction, Index Compression, Latent Semantic Indexing, Singular Value Decomposition, Query and Retrieval, Web Search, Meta Search, Web Spamming.

UNIT-III 9

Link Analysis, Social Network Analysis, Co-Citation and Bibliographic Coupling, Page Rank Algorithm, HITS Algorithm, CommModuley Discovery, Problem Definition, Bipartite Core CommModuleies, Maximum Flow CommModuleies, Email CommModuleies, Web Crawling, A Basic Crawler Algorithm – Breadth First Crawlers, Preferential Crawlers, Implementation Issues

–Fetching, Parsing, Stopword Removal, Link Extraction, Spider Traps, Page Repository, Universal Crawlers, Focused Crawlers, Topical Crawlers, Crawler Ethics and Conflicts.

UNIT-IV 9

Opinion Mining, Sentiment Classification, Classification based on Sentiment Phrases, Classification Using Text Classification Methods, Feature based Opinion Mining and Summarization, Problem Definition, Object feature extraction, Comparative Sentence and Relation Mining, Opinion Search and Opinion Spam. Web Usage Mining, Data Collection and Preprocessing, Sources and Types of Data, Key Elements of Web Usage Data Preprocessing, Data Modeling for Web Usage Mining, Discovery and Analysis of Web, Usage Patterns, Session and Visitor Analysis, Cluster Analysis and Visitor Segmentation, Association and Correlation Analysis, Analysis of Sequential and Navigation Patterns.

Textbooks/References:


1. Mining the Web: Discovering Knowledge from Hypertext Data, Soumen Chakrabarti, Morgan Kaufmann Publishers.
2. Bing Liu, Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data, Springer Publications, 2011.
3. Jiawei Han, Micheline Kamber, Data Mining: Concepts and Techniques, Second Edition, Elsevier Publications 2010.
4. Anthony Scime, Web Mining: Applications and Techniques, 2005.
5. Kowalski, Gerald, Mark T Maybury: Information Retrieval Systems: Theory and Implementation, Kluwer Academic Press, 1997.
6. Mathew Russell, Mining the Social Web 2nd Edition, Shroff Publisher/O'Reilly Publisher Publication.
7. Data Mining and Data Warehousing Principles and Practical Techniques, Parteek Bhatia, Cambridge University Press.


SCS-323 Embedded Systems for IoT

| | | |
|---|---|---|
| Course Category | : | DM |
| Pre-requisite Subject | : | NIL |
| Contact Hours/Week | : | Lecture: 3, Tutorial: 0, Practical: 0 |
| Number of Credits | : | 3 |
| Course Assessment Methods | : | Continuous assessment through tutorials, attendance, home assignments, quizzes, viva voce, minor tests, and major theory examination. |

Course Objectives:

3. To make students know the basic concept and architecture of embedded systems.
4. Different design platforms used for an embedded system for IoT applications.
5. To have knowledge about the IoT enabled technology.

Course Outcomes: After completion of course, students would be able:

1. Understand the embedded system concepts and architecture of embedded systems.
2. Understand the different hardware/software co-design techniques for microcontroller-based embedded systems.
3. Apply techniques in IoT applications.
4. To be able to design web based IoT applications.
5. To be able to design cloud based IoT applications.
6. Know the relation between embedded system, web, cloud and IoT systems.

TOPIC COVERED

UNIT-I 9

Purpose and requirement specification, IoT level specification, Functional view specification, Operational view specification, Device and component integration, Pillars of Embedded IoT and Physical Devices: The internet of devices. Design of Embedded Systems: Common Sensors, Actuators, Embedded Processors, Memory Architectures, Software architecture.

UNIT-II 9

Inputs and Outputs: Digital Inputs and Outputs, Digital Inputs, Digital Outputs, BusIn, BusOut, and BusInOut, Analog Inputs and Outputs, Analog Inputs, Analog Outputs, Pulse Width Modulation (PWM), Accelerometer and Magnetometer, SD Card, Local File System (LPC1768).

UNIT-III 9

IoT Enabling Technologies: Communications, RFID and NFC (Near-Field Communication), Bluetooth Low Energy (BLE), LiFi, 6LowPAN, ZigBee, Z-Wave, LoRa, Protocols, HTTP, WebSocket, MQTT, CoAP, XMPP, Node-RED, Platforms, IBM Watson IoT—Bluemix, Eclipse IoT, AWS IoT, Microsoft Azure IoT Suite, Google Cloud IoT, ThingWorx, GE Predix, Xively, macchina.io, Carriots.

UNIT-IV 9

Web of Things and Cloud of Things: Web of Things versus Internet of Things, Two Pillars of the Web, Architecture Standardization for WoT, Platform Middleware for WoT, Cloud of Things. IoT Physical Servers, Cloud Offerings and IoT Case Studies: Introduction to Cloud Storage Models, Communication API.

Textbooks/References:


8. RMD Sundaram Shriram K Vasudevan, Abhishek S Nagarajan, Internet of Things, John Wiley and Sons.
9. Klaus Elk, “Embedded Software for the IoT”.
10. Perry Xiao, “Designing Embedded Systems and the Internet of Things (IoT) with the ARM Mbed”.
11. Elizabeth Gootman et. al, “Designing Connected Products”, Shroff Publisher/O’Reilly Publisher.
12. Corresponding Online Resources:

Introduction to the Internet of Things and Embedded Systems, https://www.coursera.org/learn/iot

SCS-333 Scientific and Engineering Data Visualization

| | | |
|---|---|---|
| Course Category | : | DM |
| 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, records, viva voce, minor tests, major theory, and practical examination. |

Course Objective:

1. The student should be able to design principles and techniques for visualizing data.
2. Practical experience building and evaluating visualization systems.
3. Allow for project-based opportModuleies to identify, understand, analyze, prepare, and present effective visualizations on a variety of topics.

Course Outcomes: After completion of course, students would be able:

1. To design processes to develop visualization methods and visualization systems, and methods for their evaluation.
2. To understand various types of data for visualization
3. To complete preparation and processing of data.
4. To complete visual mapping and the visualization.
5. To analyze large-scale abstract data.
6. To understands various related tools and technologies: tensors, pre-processor, solver, post processor, etc.

TOPIC COVERED

UNIT-I 9

Visualization - Scientific and engineering perspective - Impact of Visualization in product design, an overview of computer graphics for visualization –Types of data for visualization, Introduction to tensors. role of pre-processor, solver and post processor in solving engineering problems. Overview of massive data visualization: Simplification methods, Multi-resolution methods, External memory methods, Visual scalability. Scalar visualization techniques: Visualization Goals, Representation of mesh and results data, mapping analysis results to Visualizations, one dimensional, two dimensional and 3D Scalar fields - Element face color coding - contour display -Isosurface techniques - Marching Cubes algorithm - Particle sampling.

UNIT-II 9

Visualization of flow data: Visualization mappings of flow data, Vector mapping - elementary icons - particle traces - streaklines, streamlines - streamribbons and streamtubes - global icons - Tensor mappings - elementary icons - global icons.

UNIT-III 9

Continuum volume display: Volume rendering Terminology, Surface and Volume rendering techniques, Optimization.

UNIT-IV 9

Applications of engineering visualization: Case studies created in the laboratory. FUTURE TRENDS: Trends in Computing Hardware, Animation, Video and multi-media, software trends in Visualization.

Textbooks/References:


1. Torsten Möller and Bernd Hamann Robert D Russell, "Mathematical Foundations of Scientific Visualization, Computer Graphics and Massive Data Exploration", Springer-Verlag Berlin Heidelberg
2. Helen Wright, "Introduction to Scientific Visualization", Springer.
3. Richard S Gallagher, "Computer Visualization: Graphics Techniques for Engineering and Scientific Analysis", CRC Press, CRC Press LLC.


## BCS-401 FAULT TOLERANCE ANALYSIS

| | |
|---|---|
| **Course Category** | PC |
| **Pre-requisite Subject** | NIL |
| **Contact Hours/Week** | Lecture: 3, Tutorial: 1 & Practical: 0 |
| **Number of Credits** | 4 |
| **Course Assessment Methods** | Continuous Assessment through Two Tests, Teacher Assessment (Quiz, Tutorial, Assignment, Attendance), and One Major Theory Examination. |

**Course Objective:** Students shall be able to

1. Understand the differences between fault, error and failure. Discuss the process by which a fault eventually causes a system failure. Understand the link between fault model and the corresponding dependability mechanisms. Introduction of terms such as fail-safe, fail-operational, fail-stop, etc. Concepts such as fault tree, FMECA, FMEA, etc.
2. HW/System: Calculate reliability of a system. Use of tools for reliability modelling. Design of dependable HW.
3. Middleware: Understand critical functions such as clock synchronisation, consensus, FDIR protocols, etc. Understand Byzantine failures and its impact on system complexity. Introduction to asynchronous message-passing distributed systems.

4. SW: Understand the various methods for SW fault tolerance. NVP, recovery blocks, run-time checks, problem of predicate detection.

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

1. Discuss the main concepts and the relationship between defect, fault and error and the main issues of fault modeling and simulation.
2. Analyze and design fault tolerant system and fault tolerant schemes/ architectures in hardware and software.
3. Demonstrate the operation of the most popular fault tolerant approaches used in digital systems and computer networks.
4. Apply the concepts of availability, dependability, and reliability in the design of software.
5. Understand techniques to model faults and know how to generate tests and evaluate effectiveness.
6. Evaluate reliability of systems with permanent and temporary faults.

**TOPIC COVERED**

**UNIT-I** **9L**

Fault Classification, Types of Redundancy, Basic Measures of Fault Tolerance: Traditional and Network, Failure Rate, Reliability, and Mean Time to Failure, Canonical and Resilient Structures, Reliability Evaluation Techniques, Fault-Tolerance Processor-Level Techniques, Byzantine Failures.

**UNIT-II** **9L**

Fault Tolerant Design: Basic Concepts, N-Modular Redundancy (NMR), Use of Error Correcting Codes, Dynamic, Hybrid and Self Purging Redundancy, Sift-out Modular Redundancy (SMR), Triple Modular Redundancy, SMR Reconfiguration.

**UNIT-III** **9L**

Information Redundancy Coding, Resilient Disk Systems, Data Replication, Algorithm-Based Fault Tolerance. Fault-Tolerant Networks Measures of Resilience, Common Network Topologies and their Resilience, Fault-Tolerant Routing, Software Fault Tolerance Acceptance Tests, Single-Version Fault Tolerance, N-Version Programming, Recovery Block Approach, Preconditions, Postconditions, and Assertions, Exception-Handling, Software Reliability Models, Fault-Tolerance Remote Procedure Call.

**UNIT-IV** **9L**

Checkpointing What is Checkpointing? Checkpoint Level, Optimal Checkpointing – An Analytical Model, Cache-Aided Rollback Error Recovery (CARER), Checkpointing in Distributed Systems, Checkpointing in Shared-Memory Systems, Check pointing in Real-Time Systems, Other. Uses of Checkpointing. Fault Detection in Cryptographic Systems Overview of Ciphers, Security Attacks Through Fault Injection, Countermeasures.

**TEXTBOOKS**


1. Israel Koren and C. Mani. Krishna, “Fault Tolerant Systems”, Elsevier.2007.
2. D. K. Pradhan, “Fault-Tolerant Computing, Theory and Techniques”, Prentice-Hall, 1998.

3. P. Jalote, “Fault Tolerance in Distributed Systems”, Prentice-Hall Inc. 1994.
4. Hoang Pham, “System Software Reliability”, Springer 2006.

**REFERENCE BOOK**

1. Elena Dubrova; Fault-Tolerant Design; Springer, 2013
2. Michael R. Lyu; Handbook of Software Reliability Engineering; IEEE Computer Society Press (and McGraw-Hill), 1996
3. Martin L. Shooman; Reliability of Computer Systems and Networks: Fault Tolerance, Analysis, and Design; John Wiley & Sons Inc., 2002
4. Kishor S. Trivedi; Probability and Statistics with Reliability, Queuing and Computer Science Applications; John Wiley & Sons Inc., 2016
5. Magdi S. Mahmoud, Yuanqing Xia, “Analysis and Synthesis of Fault-Tolerant Control Systems”, John Wiley & Sons, 2014.

**BCS-402 Cryptography and Information Security**

| | |
|---|---|
| **Course Category** | PC |
| **Pre-requisite Subject** | Nil |
| **Contact Hours/Week** | Lecture: 3, Tutorial: 1 & Practical: 0 |
| **Number of Credits** | 4 |
| **Course Assessment Methods** | Continuous Assessment through Two Tests, Teacher Assessment (Quiz, Tutorial, Assignment, Attendance), and One Major Theory Examination. |

**Course Objective:** This course helps the students in gaining the knowledge of basic principle of Cryptography and Information Security. This course also helps to undertake future courses that assume as a background in Cryptography and Information Security.

1. Discuss basic theory and practice of Cryptography and Information Security
2. Design and implement new Cryptography and Information Security

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

1. Encryption techniques and key generation techniques.
2. Authentication and security measures.
3. Intrusion and filtering analysis.
4. Become familiar with fundamentals of Cryptography and Information Security and with the way these Cryptography and Information Security can best be implemented
5. Become accustomed to the description of Cryptography and Information Security in both functional and procedural styles
6. Devise and analyse potential solutions for emerging issues.

**TOPIC COVERED**

**UNIT-I** **9L**

Introduction to Cryptography, Attacks, Services and Mechanism, Conventional Encryption Model, Classical Encryption Techniques- Substitution Ciphers and Transposition Ciphers, Cryptanalysis, Steganography, Stream and Block Ciphers, Modern Block Ciphers: Block Ciphers Principals, Data Encryption Standard (DES), Strength of DES, Differential and Linear Crypt Analysis of DES, Block Cipher Modes of Operations, Triple DES, IDEA Encryption and Decryption, Strength of IDEA, Confidentiality using Conventional Encryption, Traffic Confidentiality, Key Distribution, Random Number Generation.

**UNIT-II** **9L**

Introduction to Graph, Ring and Field, Prime and Relative Prime Numbers, Modular Arithmetic, Fermat‟s and Euler‟s Theorem, Euclid‟s Algorithm, Chinese Remainder Theorem. Principals of Public Key Crypto Systems, RSA Algorithm, Security of RSA, Key Management, DiffleHellman Key Exchange Algorithm, Elganel Encryption.

**UNIT-III** **9L**

Message Authentication and Hash Function: Authentication Requirements, Authentication Functions, Message Authentication Code, Hash Functions, Birthday Attacks, Security of Hash Functions and MACS, MD5 Message Digest Algorithm, Secure Hash Algorithm (SHA). Digital Signatures: Digital Signatures, Authentication Protocols, Digital Signature Standards (DSS), Authentication Applications: Kerberos, Electronic Mail Security-Pretty Good Privacy (PGP), S/MIME.

**UNIT-IV** **9L**

IP Security: Architecture, Authentication Header, Encapsulating Security Payloads, Combining Security Associations, Key Management. Web Security: Secure Socket Layer and Transport Layer Security, Secure Electronic Transaction (SET), System Security: Intruders, Viruses and Related Threads, Firewall Design Principals, Trusted Systems. 9

**TEXTBOOKS**


1. William Stallings, Cryptography and Network Security: Principals and Practice, Pearson Publication.
2. Johannes A. Buchmann, Introduction to Cryptography, Springer-Verlag.
3. Bruce Schiener, Applied Cryptography, John Wiley and Sons, 1996
4. Behrouz A. Frouzan, Cryptography & Network Security, Tata McGraw Hill
5. Bruce Schiener, Applied Cryptography, John Wiley & Sons 6. Atul Kahate, “Cryptography and Network Security” Tata McGraw Hil
6. Atul Kahate, “Cryptography and Network Security” Tata McGraw Hill

**REFERENCE BOOKS**


1. Charlie Kaufman, Radia Perlman, Mike Speciner, Network Security, Private communication in public world, PHI Second Edition, 2002
2. Douglas R Simson, Cryptography – Theory and practice, CRC Press, First Edition, 1995


**BCS-403 Introduction to Functional and Logic Programming**

| | |
|---|---|
| **Course Category** | PC |
| **Pre-requisite Subject** | NIL |
| **Contact Hours/Week** | Lecture: 3, Tutorial: 0 & Practical: 2 |
| **Number of Credits** | 4 |
| **Course Assessment Methods** | Continuous Assessment through Two Tests, Teacher Assessment (Quiz, Tutorial, Assignment, Attendance), Practical Work & Viva-voce, and One Major Theory & One Practical Examinations. |

**Course Objective:** This course helps the students to aware about various cybercrimes and how to protect themselves. The course objectives of above course are-

1. To understand different programming paradigms and the relationship between programming paradigm and underlying mathematical computational model.
2. To understand different approaches to solving problems: functional and logic programming.
3. To get practical experience using most widely used functional and logic programming languages: Haskell and Prolog

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

1. Understand different approaches to solving problems: functional decomposition and logic programming.
2. Understand the lambda-calculus with programming languages and the process of computation.
3. Demonstrate functional Programming Paradigm using Haskell.
4. Demonstrate Logic Programming Paradigm using Prolog
5. Demonstrate Logic Programming Paradigm, Prolog execution models, Prolog's basic and advanced prolog concepts such as LIST, CUT, and Fail using illustrative
6. Interpret the logical consequences and validity of formulae using the rules of propositional and predicate logic programming examples.

**TOPIC COVERED**

**UNIT-I** **9L**

Distinctive features of functional programming languages, functional programming in imperative language, recursion, tail recursion, higher order functions, lazy evaluation, types in functional programming, mathematics of functional programming: lambda calculus.

**UNIT-II** **9L**

Introduction to Haskell, defining functions: guards, pattern matching and recursion, Lists, strings and tuples, Types and polymorphism, Higher order functions on lists: map, filter, list comprehension, Computation as rewriting, lazy evaluation and infinite data structures.

**UNIT-III** **9L**

Logic and Reasoning, Logic programs, Prolog syntax and its principal primitives. Some important techniques: tail recursion, accumulators, difference lists.

**UNIT-IV** **9L**

Some applications of Logic Programming such as simple theorem proving, Natural Language Processing, Expert Systems. Implementation of logic programs. Constraint Logic Programming: constraint satisfaction, constraint propagation- rationale, methodology and examples.

**EXPERIMENTS**

1. Define a function in Haskell isPerfect :: Integer -> Bool that checks if the given input (a positive integer) is a *perfect number*. A positive integer is perfect if it is the sum of all its proper divisors.
2. Define a function in Haskell partitioned :: [Int] -> Bool that returns True if there is an element n of the list such that:

- for each element m occurring before n in the list, m ≤ n, and
- for each element m occurring after n in the list, m > n.

3. Define a function in Haskell connected :: [String] -> Bool that checks whether the input list of strings is connected. A list of strings is connected if:

- each string in the list (other than the first) is obtained from the previous one by changing the character in exactly one position, and
- no string occurs twice in the list.

4. Define a function in Haskell *segments* which takes a finite list *xs* as its argument and returns the list of all the segments of *xs*. (A segment of *xs* is a selection of adjacent elements of *xs*.)

Sample cases:
segments [] = [[]]
segments [1,2,3] = [[1,2,3], [1,2], [2,3], [1], [2], [3]]

5. A list of numbers is said to be steep if each element of the list is at least as large as the sum of the preceding elements. Define a function in Haskell *llsg* such that *llsg xs* is the length of the longest steep segment of *xs*.
   Sample cases:
   llsg [] = 0
   llsg [1,2] = 2
   llsg [1,2,3,5,12,17] = 4
6. Write a program in Haskell to show the working of list comprehension.
7. Write a program in Haskell to show the working of map and filter.
8. Write a program in Haskell to show the implementation of lazy computation.
9. Write a program in Prolog to compute the factorial of a number.
10. Write a program in Prolog to find a number is prime or not.
11. Write a program in Prolog to print a two-dimensional pattern.

12. Write a program in Prolog to demonstrate tail recursion.
13. Write a program in Prolog to demonstrate tail accumulators.
14. Write a program in Prolog to demonstrate list.

**TEXTBOOKS**


1. C. Reade, Elements of Functional Programming, Addison Wesley, 1989.
2. Simon Thompson, "Haskell:The Craft of Functional Programming", 2nd edition, Addison Wesley.
3. W.F. Clocksin and C.S. Mellish, Programming in Prolog, Springer-Verlag, 1987.
4. JW Lloyd. Foundations of Logic Programming. Springer Verlag, 1987.


**REFERENCE BOOK**


1. Hogger C J, Introduction to Logic Programming, Academic Press.
2. L. Stirling and E. Shapiro, The Art of Prolog: Advanced Programming Techniques, MIT Press, 2nd edition, 1994.
3. J. R. Hindley and H. P. Seldin, Introduction to Combinators and Lambda-calculus, Cambridge University Press, 1988.


**BCS-426 Game Theory**

| | |
|---|---|
| Course category: | Program Elective-3(PE3) |
| Pre-requisite Subject: | NIL |
| Contact hours/week: | Lecture: 3, Tutorial: 1, Practical: 0 |
| Number of Credits: | 4 |
| Course Assessment methods: | Continuous Assessment through Two Tests, Teacher Assessment (Quiz, Tutorial, Assignment, Attendance), and One Major Theory Examination. |

**Course Objective:** It contains a basic introduction to familiarize students with the basics of game programming. Here are the key objectives covered in this course.

1. Be able to take conflicts or problems from your everyday life, history, nature or society and interpreted them in game theory terms.
2. Solve games beyond the most basic models involving, for example incomplete and asymmetric information, sequential games and repeated games.
3. Have a thorough knowledge of the equilibrium concept in game theory and how the simple Nash Equilibrium can be amended to apply to more complex games.
4. Know the modern history of game theory and how it has evolved.

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

1. Discuss the basics of games and the mathematics for games as well as the typical application areas for game theory.
2. Explain the concepts of non-cooperative and cooperative games and the basic computational issues.

3. Describe the concepts of Games with Perfect Information as well as Games with Imperfect Information.
4. Study the non-cooperative game theory.
5. Designing the mechanisms and understand the computational applications of mechanism design.
6. Give an account of how game theory influences policy and decision making

**UNIT-I** **9L**

Introduction Making Rational Choices: Basics of Games – Strategy - Preferences – Payoffs – Mathematical Basics -Game Theory-Rational Choice - Basic Solution Concepts- Non-Cooperative versus Cooperative Games - Basic Computational Issues - Finding Equilibrium and Learning in Games- Typical Application Areas for Game Theory (e.g. Google's Sponsored Search, ebay Auctions, Electricity Trading Markets)

**UNIT-II** **9L**

**Games With Perfect Information**- Strategic Games - Prisoner's Dilemma, Matching Pennies- Nash Equilibrium- Theory and Illustrations - Cournot's and Bertrand's Models of Oligopoly- Auctions- Mixed Strategy Equilibrium- Zero-Sum Games- Extensive Games with Perfect Information-Repeated Games (Prisoner's Dilemma)- Sub Game Perfect Nash Equilibrium; Computational Issues.

**Games with Imperfect Information**- Bayesian Games – Motivational Examples – General Definitions –Information Aspects – Illustrations - Extensive Games with Imperfect - Information - Strategies- Nash Equilibrium – Beliefs and Sequential Equilibrium – Illustrations - Repeated Games - Prisoner's Dilemma - Bargaining

**UNIT-III** **9L**

**NON-COOPERATIVE GAME THEORY**-Non-Cooperative Game Theory - Self-Interested Agents- Games in Normal Form – Analyzing Games: from Optimality to Equilibrium - Computing Solution Concepts of Normal-Form Games - Computing Nash Equilibrium of Two-Player, Zero-Sum Games -Computing Nash Equilibrium of Two-Player, General-Sum Games - Identifying Dominated Strategies

**UNIT-IV** **9L**

**MECHANISM DESIGN**-Aggregating Preferences-Social Choice – Formal Model- Voting - Existence of Social Functions - Ranking Systems - Protocols for Strategic Agents: Mechanism Design - Mechanism Design with Unrestricted Preferences- Efficient Mechanisms - Vickrey and VCG Mechanisms (Shortest Paths) - Combinatorial Auctions - Profit Maximization Computational Applications of Mechanism Design -Applications in Computer Science - Google's Sponsored Search - ebay Auctions

**Textbooks:**

18. Kevin Leyton-Brown, Yoav Shoham, Ronald J Brachman, Thomas Dietterich, Essentials of Game Theory, Morgan and Claypool Publishers, 2008

19. Roger A McCain, Game Theory: A Nontechnical Introduction to the Analysis of Strategy,
20. Fudenberg, Drew, and Jean Tirole, Game Theory, Cambridge, MA: MIT Press, 1991
21. Osborne, Martin, and Ariel Rubinstein. A Course in Game Theory. Cambridge, MA: MIT Press, 1994
22. Mailath, George J., and Larry Samuelson, *Repeated Games and Reputations*. New York, NY: Oxford University Press, 2006

**BCS-427 Computer Vision: Foundation and Applications**

| | |
|---|---|
| Course category: | Program Elective-3(PE3) |
| Pre-requisite Subject: | NIL |
| Contact hours/week: | Lecture: 3, Tutorial: 1, Practical: 0 |
| Number of Credits: | 4 |
| Course Assessment methods: | Continuous Assessment through Two Tests, Teacher Assessment (Quiz, Tutorial, Assignment, Attendance), and One Major Theory Examination. |

**Course Objective:** It contains a basic introduction to familiarize students with the basics of game programming. Here are the key objectives covered in this course.

1. Understand the various operations performed on 2D image.
2. To recover the information, knowledge about the objects in the scene and projection geometry and understanding of 3D image.

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

1. Describe image segmentation as a clustering problem and be able to compare different clustering algorithms for segmenting images
2. Describe interest points and Local Feature in images, compare the strengths and weaknesses of different Local Features and apply them to solve object recognition, image retrieval and stereo-based scene reconstruction problems.
3. Describe and compare model-based object recognition algorithms and analyse the strengths and weaknesses of model-based vs image-based object recognition computer vision systems.
4. Describe the basic steps of stereopsis, analyse the differences between sparse and dense stereo vision matching algorithms and apply them to solve stereo-based scene reconstruction problems.
5. Describe the basic steps of rigid and non-rigid image registration algorithms and analyse their use to biomedical image applications.
6. To introduce the student to computer vision algorithms, methods and concepts which will enable the student to implement computer vision systems with emphasis on applications and problem solving. Lab exercises will familiarize the student with typical hardware as well as software development tools.

**UNIT-I** **9L**

Introduction: Computer Vision, Brief History. Image Formation: Geometric Primitives and Transformations, Photometric Image Formation, Digital Camera. Image Processing: Point Operators, Linear Filtering, Neighborhood Operators, Fourier Transform, Pyramids and Wavelet, Geometric Transforms, Global Optimization.

**UNIT-II** **9L**

**Feature Detection and Matching:** Points and Patches, Edges, Lines. **Segmentation:** Active Contours: Snakes, Dynamic Snake and Condensation, Scissor, Level Sets, Split and Merge, Mean Shift and Mode Finding, **Feature Based Alignment:** 2D and 3D Feature Based Alignment, Pose Estimation, Geometric Intrinsic Calibration.

**UNIT-III** **9L**

**Structure from Motion:** Triangulation, Two Frame Structure from Motion, Factorization, Bundle Adjustment. **Dense Motion Estimation:** Translational Alignment, Parametric Motion, Spline Based Motion, Layered Motion. **Image Stitching:** Motion Models, Global Alignment, Composing.

**UNIT-IV** **9L**

**3D Reconstruction:** Surface Representation, Point based Representation, Volumetric Representation, Model based Reconstruction, Application: 3D Photography. **Image Based Rendering:** View Interpolation, Layered Depth Images, Video based Rendering. **Recognition:** Object Detection, Face Recognition, Context and Scene Understanding.

**Textbooks:**


23. R. Szeliski, Computer Vision: Algorithms and Applications, Springer.
24. D. Forsyth and J. Ponce, Computer Vision- A Modern Approach, Prentice Hall
25. B. K. P. Horn, Robot Vision, McGraw Hill.
26. E. Trucco and A. Verri, Introductory Techniques for 3D Computer Vision, Publisher: Prentice Hall.


**BCS- 428 HIGH PERFORMANCE COMPUTING ARCHITECTURES**

| | |
|---|---|
| **Course Category** | Program Elective (PE) |
| **Pre-requisite Subject** | Computer Organization and Architecture |
| **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 Two Minor tests and One Major Theory Examination |

**Course Objective:** This course helps the students in gaining the knowledge of Various Computing Architectures and Modern Processors. The principal objectives of this course are:

1. To make students know about the Parallelism concepts in Programming
2. To give the students an elaborate idea about the different memory systems and buses.
3. To introduce the advanced processor architectures to the students.
4. To make the students know about the importance of multiprocessor and multicomputers.
5. To study about data flow computer architectures

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

The students will be able to

1. Demonstrate concepts of parallelism in hardware/software.
2. Discuss memory organization and mapping techniques.
3. Describe architectural features of advanced processors.
4. Interpret performance of different pipelined processors.
5. Explain data flow in arithmetic algorithms
6. Development of software to solve computationally intensive problems

**Topics Covered**

**UNIT-I**
**9L**

Classification of Instruction Set Architectures, RISC Processors, Characteristics of RISC Processors, RISC vs CISC, Review of Performance Measurements, Basic Parallel Processing Techniques: Instruction Level, Thread Level and Process Level, Classification of Parallel Architectures.

**UNIT-II** **9L**

Basic Concepts of Pipelining, Arithmetic Pipelines, Instruction Pipelines, Hazards in A Pipeline: Structural, Data, and Control Hazards, Overview of Hazard Resolution Techniques, Dynamic Instruction Scheduling, Branch Prediction Techniques, Instruction-Level Parallelism using Software Approaches, Superscalar Techniques, Speculative Execution.

**UNIT-III** **9L**

Basic Concept of Hierarchical Memory Organization, Main Memories, Cache Design and Optimization, Virtual Memory Design and Implementation, Memory Protection, Evaluating Memory Hierarchy Performance, RAID, Centralized vs. Distributed Shared Memory.

**UNIT-IV** **9L**

Interconnection Topologies, Synchronization, Memory Consistency, Review of Modern Multiprocessors, Distributed Computers, Clusters, Grid, Mainframe Computers, Bus Structures and Standards, Types and Uses of Storage Devices, Interfacing I/O to The Rest of the System, Reliability and Availability, I/O System Design.

**Textbooks**


1. Hennessey and Patterson, Computer Architecture: A quantitative Approach, Morgan Kaufman.
2. Kai Hwang, Advanced Computer Architecture: Parallelism, Scalability, Programmability, McGraw-Hill.
3. SIMA, Advanced Computer Architectures, Addison-Wesley.

**Reference books**


1. H.S. Stone, High-performance Computer Architecture, 3rd edition, Addison-Wesley, 1993.
2. Patterson, D. A. and Hennessy, J. L., Computer Organization and Design: The Hardware/ Software Interface, Morgan Kaufmann, 1998


### SCS- 415 Analyzing, Visualizing and Applying Data Science with Python

| | |
|---|---|
| **Course Category** | DM |
| **Pre-requisite Subject** | NIL |
| **Contact Hours/Week** | 4 (L: 3; T: 1; P: 0) |
| **Number of Credits** | 4 |
| **Course Assessment Methods** | Continuous Assessment through Two Tests, Teacher Assessment (Quiz, Tutorial, Assignment, Attendance), and One Major Theory Examination |

**Course Objective:**

1. To learn how to use python for data science.
2. To understand and use all the tools and libraries of python for data science.

**Course Outcomes:** After successfully completing the course the students would be able

1. To explain how data is can be collected from the Web.
2. To extract data and information from the webpages.
3. To make decision based on the data collected.
4. Clean and prepare data for analysis
5. Importing and Exporting Data in Python
6. Over-fitting, Under-fitting and Model Selection

**TOPIC COVERED**

**UNIT-I** **9L**

Data Analysis libraries: will learn to use Pandas Data Frames, NumPy, multi-dimensional arrays, and SciPy libraries to work with a various dataset.

**UNIT-II** **9L**

Pandas, an open-source library, and we will use it to load, manipulate, analyze, and visualize various datasets.

**UNIT-III** **9L**

Scikit-learn, and we will use some of its machine learning algorithms to build smart models and make predictions, various parameters that can be used to compare various parameters.

**UNIT-IV** **9L**

Descriptive Statistics, Basic of Grouping, ANOVA, Correlation, Polynomial Regression and Pipelines, R-squared and MSE for In-Sample Evaluation, Prediction and Decision Making.

**EXPERIMENTS**

1. Demonstrate knowledge of Data Science and Machine Learning.
2. Apply Data Science process to a real-life scenario.
3. Explore New York City - 311 Complaints and Housing datasets.
4. Analyse and Visualize data using Python.
5. Perform feature engineering exercise using Python.
6. Build and validate predictive machine learning model using Python.
7. Create and share Actionable Insights to real life data problems.

**TEXTBOOKS**

1. Data Visualization with Python and JavaScript, Kyran Dale, Shroff Publisher/O'Reilly Publisher Publication.
2. Data Science Using Python and R by Chantal D. Larose and Daniel T. Larose, Wiley Publication.

**REFERENCE BOOK**

1. Python for Data Science and Visualization -Beginners to Pro, Udemy.

**SCS-425 IoT with Arduino, ESP, and Raspberry Pi**

| | |
|---|---|
| **Course Category** | DM |
| **Pre-requisite Subject** | NIL |
| **Contact Hours/Week** | Lecture: 3, Tutorial: 1 & Practical: 0 |
| **Number of Credits** | 4 |
| **Course Assessment Methods** | Continuous Assessment through Two Tests, Teacher Assessment (Quiz, Tutorial, Assignment, Attendance), and One Major Theory Examination |

**Course Objective:**

- To give students hands-on experience using different IoT architectures.
- To provide skills for interfacing sensors and actuators with different IoT architectures.
- To develop skills on data collection and logging in the cloud.

**Course Outcomes:** After successfully completing the course the students would be able

1. To understand Arduino Uno, NODE MCU 8266 and Raspberry PI along with critical protocols and its communication to cloud.
2. To apply commonly used IOT protocols such as REST API, MQTT through IOT based demonstration.
3. To solve analog sensor and digital sensor Interfacing with IOT devices.
4. Able to Understand How to Work with Arduino, Raspberry Pi and ESP8266 in Details
5. Create Own IoT Apps and Usecases
6. Be More Aware on the Hardware side of IoT with in Depth Knowledge

**TOPIC COVERED**

**UNIT-I** **9L**

IoT- introduction and its components, IoT building blocks, Sensors and Actuators, IoT Devices, IoT boards (Arduino Uno, ESP 8266-12E Node MCU, and Raspberry Pi 3).
Arduino Uno – getting started with the Uno boards, blink program, connection of sensors to the Uno board, reading values of sensors from the Uno board, interrupts. Case study: Temperature/Humidity Control; Case Study: Sending values Temperature/Humidity values to the Internet via GSM module.

**UNIT-II** **9L**

ESP 8266-12E Node MCU – getting started with the ESP board, Micro python and Explorer IDE, Flushing the ESP8266 board with micro python, connecting sensors to the ESP board, Connecting ESP board to WiFi, Interfacing ESP with the Cloud (REST API-GET, POST, MQTT), interrupts, comparison of ESP 32 board with the ESP 8266 board. Case Study: Switching light on /off remotely. Case Study: Voice-based Home Automation for switching lights on/off (Android phone – Google Assistant (Assistant <-> IFTTT), MQTT (ESP <-> IFTTT), ESP 8266 <-> Lights).

**UNIT-III** **9L**

Raspberry Pi 3 - Rpi3 introduction and installing the Raspbian Stretch OS, Headless - Computer and Rpi3 configuration to connect through SSH via Ethernet, Headless - connecting Rpi3 remotely without Ethernet cable via SSH, IP address, Rpi 3 - Testing the GPIO pins through Scripts.

**UNIT-IV** **9L**

Raspberry pi3 interfacing with Sensor DHT11, Raspberry pi3 python library install and reading sensor feed, 'Plug and play ' type cloud platform overview for integration to IOT devices, 'Plug and play' cloud platform for integration to IOT device - actuator (LED), Plug and play platform - Custom widget (DHT11-Sensor) integration through Python. New - Raspeberry Pi 4 Vs Raspberry Pi3 Mobel B Comparison, LoRawan /LPWAN – Overview.

**EXPERIMENTS**

1. Wearable Computer With Temperature Distance Sensors
2. IOT Water Pollution Monitor RC Boat
3. Voice Controlled Air Purifier
4. Contactless IOT Doorbell
5. IOT Contactless Covid Testing Booth Automation
6. Face Recognition Door Lock System Using Raspberry Pi
7. Raspberry Pi Vehicle Anti-Theft Face Recognition System
8. Voice Based Hot Cold-Water Dispenser System using Raspberry Pi
9. IOT Garbage Monitoring Using Raspberry Pi
10. Women Safety Night Patrolling Robot Ras Pi
11. Raspberry Pi Air & Noise Pollution Monitoring System IOT
12. Speaking System For Mute People Using Hand Gestures
13. Raspberry Pi Based Reader For Blind
14. Raspberry Pi Wheelchair With Safety System
15. Raspberry Pi Speaking Bus Stop Reminder

16. IOT Based ICU Patient Monitoring System
17. Drink & Drive Detection With Ignition Lock Project
18. IOT Theft Detection Using Raspberry Pi
19. Raspberry Pi Vehicle Number Plate Recognition
20. Drunk Driving Detection With Car Ignition Locking
21. IOT Home Automation Using Raspberry Pi
22. Camera Based Surveillance System Using Raspberry Pi
23. Automated Door Opener With Lighting Control Using Raspberry Pi
24. Image Processing Based Fire Detection Using Raspberry Pi

**TEXTBOOKS**


1. Rao, M. (2018). Internet of Things with Raspberry Pi 3: Leverage the power of Raspberry Pi 3 and JavaScript to build exciting IoT projects. Packt Publishing Ltd
2. Baichtal, J. (2013). *Arduino for beginners: essential skills every maker needs*. Pearson Education.
3. Schwartz, M. (2016). *Internet of Things with ESP8266*. Packt Publishing Ltd.


**REFERENCE BOOK**


1. Richardson, M., & Wallace, S. (2012). *Getting started with raspberry PI*. " O'Reilly Publisher Media, Inc."


**SCS- 435 Mobile VR and AI in Moduley**

| | |
|---|---|
| **Course Category** | DM |
| **Pre-requisite Subject** | NIL |
| **Contact Hours/Week** | Lecture: 3, Tutorial: 1 & Practical: 0 |
| **Number of Credits** | 4 |
| **Course Assessment Methods** | Continuous Assessment through Two Tests, Teacher Assessment (Quiz, Tutorial, Assignment, Attendance), and One Major Theory Examination |

**Course Objective:**

1. To give students hands-on exposure to mobile virtual reality in Moduley.
2. To give students experience with basic AI algorithms in virtual reality.
3. To provide students with fundamentals of game designs in virtual reality.

**Course Outcomes:**

After successfully completing the course the students would be able

1. To learn to code for game development in Moduley C#
2. To understand the fundamentals of game design.
3. To learn to use AI algorithms (A*, IL, and RL) in Moduley-ML.
4. Describe the origin of virtual reality technology and identify its unique features as compared with earlier communications media.
5. Analyze, differentiate, and evaluate the differences between current virtual reality devices as well as their respective environments, uses, perils, and promise
6. Identify various practical applications for virtual reality technologies in human interaction/communication

**TOPIC COVERED**

**UNIT-I** **9L**

Introduction to Moduley, Moduley Editor, Moving a Cube, Lights, Particle Systems, Applying Physics, and Moduley Asset Store, C# Coding Introduction, Variables, Methods, If Blocks, Loops, Hello Mammoth, User Interaction in Moduley, Inputs Introduction Preview, Key Presses, Moving a Player, Jumping, Moving Forward, Cycling Cameras, Prefabs Introduction, What are Prefabs? Instantiating Objects, Random Angles, Destroying Objects, Explosion Effects, Adding Explosion Effects.

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**UNIT-II** **9L**

Developing a Pathfinding Game, How to Set Up a Project, Node, String Map, A* Algorithm Setup, A* Algorithm Loop, Auxiliary Methods, Finishing the Algorithm, Importing 2D Assets, Building a Level, From Console to Visual, Adding Tanks, Identifying Nodes, Moving the Tank, Visually Moving Tank, Smooth Movement, Smooth Rotation, Ordering Tank to Move, Speeding up Player, Spawning Logic, Crate Visuals, Adding Crates to Valid Positions, Collecting Crates, Score Counting, Game Interface, Starting the Game, Game Over Screen, Scoring, Sounds.

**UNIT-III** **9L**

VR Introduction - Moduley, Activating VR, Building a Castle, Camera Changing Position, Lowering Castle Doors, Triggering Events Interface, Blender, Download and Install Blender, Introduction & Customizing Settings, Controlling Blender Camera, Emulate Numpad Camera, Manipulating Objects, Common Tools, Mirroring 1 Side of Object. Case Study: Flappy bird Moduley game, First person shooter game, Kart Moduley game.

**UNIT-IV** **9L**

Introduction to Moduley-ML, Why Machine Learning, different kinds of learnings, Neural Networks (NNs), Training a NN, Optimizer, Convolutional layers, Transfer learning, Imitation learning in Moduley, Training the kart in kart game via IL, Testing the drive. Introduction to Reinforcement Learning in Moduley-ML, Reinforcement Learning, Initial state, training a policy, The PPO algorithm, Evolutional Strategies

**TEXTBOOKS**


1. Linowes, J., & Schoen, M. (2016). Cardboard VR Projects for Android. Packt Publishing Ltd.
2. Lanham, M. (2019). Hands-On Deep Learning for Games: Leverage the power of neural networks and reinforcement learning to build intelligent games. Packt Publishing Ltd.


**REFERENCE BOOK**


1. Aversa, D., Kyaw, A. S., & Peters, C. (2018). Moduley Artificial Intelligence Programming: Add powerful, believable, and fun AI entities in your game with the power of Moduley 2018! Packt Publishing Ltd.

**ICS-401** **Software Quality Management**

| | |
|---|---|
| Course category: | Industrial Elective # (IE#) |
| Pre-requisite Subject: | NIL |
| Contact hours/week: | Lecture: 3, Tutorial: 1, Practical: 0 |
| Number of Credits: | 4 |
| Course Assessment methods: | Continuous Assessment through Two Tests, Teacher Assessment (Quiz, Tutorial, Assignment, Attendance), and One Major Theory Examination. |

**Course Objective:** It contains a basic introduction to familiarize students with the basics of game programming. Here are the key objectives covered in this course.

1. definitions of quality of software product and software process;
2. definitions of software quality assurance, software metrics and models in quality management, internal quality and external quality;

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

1. understanding of software quality and approaches to assure software quality
2. Define quality assurance plans
3. Apply quality assurance tools & techniques
4. To learn about standards and certifications
5. To describe procedures and work instructions in software organizations
6. the tools for software quality management, and the methods for working with defects as part of quality management, i.e., Bayesian data analysis;

**UNIT-I** **9L**

INTRODUCTION: Software Quality Challenge - Software Quality Factors - Components of the Software Quality Assurance System. Pre-Project Software Quality Components - Contract Review - Development and Quality Plans

**UNIT-II** **9L**

SQA COMPONENTS IN THE PROJECT LIFE CYCLE : Integrating Quality Activities in the Project Life Cycle – Reviews - Software Testing – Strategies - Software Testing –Implementation - Assuring the Quality of Software Maintenance - Assuring The Quality of External Participants' Parts - Case Tools and their effect on Software Quality.

**UNIT-III** **9L**

SOFTWARE QUALITY INFRASTRUCTURE COMPONENTS: Procedures and Work Instructions - Supporting Quality Devices - Staff Training, Instructing and Certification - Preventive and Corrective Actions - Configuration Management - Documentation and Quality Records Controls.

**UNIT-IV** **9L**

SOFTWARE QUALITY MANAGEMENT COMPONENTS & STANDARDS: Project Progress Control - Components of Project Progress Control- Progress control of internal projects and external participants- Implementation of Project Progress Control, ISO 9001 Certification - Software Process Assessment. Organizing for Quality Assurance -Management and its Role in Quality Assurance - Software Quality Assurance Unit - SQA Trustees and Committees

**Textbooks:**


27. Daniel Galin, Software Quality Assurance: From Theory to Implementation, Pearson Addison-Wesley, 2012.
28. Jeff Tian, Software Quality Engineering (SQE), Wiley-Interscience, 2005
29. Stephen H Kan, Metrics & Models in Software Quality Engineering, Pearson Education


**ICS- 402 Software Reliability**

| | |
|---|---|
| **Course Category** | Industrial Elective # (IE#) |
| **Pre-requisite Subject** | NIL |
| **Contact Hours/Week** | Lecture: 3, Tutorial: 1 & Practical: 0 |
| **Number of Credits** | 4 |
| **Course Assessment Methods** | Continuous Assessment through Two Tests, Teacher Assessment (Quiz, Tutorial, Assignment, Attendance), and One Major Theory Examination. |

**Course Objective:** It is a step-by-step description of software quality and software reliability engineering process. It includes introduction to software quality, prediction and measurement of software size and cost, software reliability engineering process, defining necessary reliability, developing operational profiles, decision making based on the test results, techniques to improve and predict software reliability, application of quality concept to agile and incremental software development processes

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

1. Clearly specify what correctness means for a given software system, and modularly for its components.
2. Design software in ways that make fine-grained testing and informal reasoning about correctness easier than alternative designs.
3. Write (manually) suites of tests that validate specific portions of specifications.
4. Understand the strengths and weaknesses of various automated validation techniques, such as test generation and static analysis
5. Select appropriate validation methods for a given project
6. Clearly and persuasively argue that some validation technique (e.g., test suite) adequately exercises both the relevant program component and its specification.

**TOPIC COVERED**

**UNIT-I** **9L**

**Overview of software reliability engineering**: What is software reliability? What factors affect software quality? What is software reliability engineering?

**Software Size**: Size: Length (code, specification, design), Size: Reuse, Size: Functionality (function point, feature point, object point, use-case point), Size: Complexity
**Review of software Reliability Models**: Basic Features of the Software Reliability Models, Single Failure Model, Reliability Growth Model, Exponential Failure Class Models, Weibull and Gamma Failure Class Models, Infinite Failure Category Models, Bayesian Models, Early Life-Cycle Prediction Models

**UNIT-II** **9L**

**Defining necessary reliability**: Introducing failure severity class and failure intensity objective concepts, Steps in defining necessary reliability, Computing failure intensity objective for developed software, Case studies
**System reliability**: System reliability, Reliability Block Diagram (RBD), Serial and parallel configuration, Active redundancy, Hazard analysis: FMEA, FTA
**Strategies to meet reliability objective**: Fault prevention strategy: software product and process improvement using ISO 9000-3, Introducing fault tolerance concepts and definitions, Coincident, correlated and dependent faults, Fault tolerance phases, Recovery block mechanism and Acceptance testing, Exception handling, expected and unexpected events, Construction of robust software systems, Defensive programming, dual software technique, Adjudication by voting, Recovery blocks, N-version programming, Consensus recovery block, Acceptance voting, N self-checking programming.

**UNIT-III** **9L**

**Developing operational profiles**: Defining function, operation, run, run type, operational mode, operational profile, Representation of operational profile, Procedure to define operational profile, Create functions/operations list, Determine occurrence rate of individual operations, Determine occurrence probabilities.
**Preparing and executing test**: Direct and indirect input variables, Operation, load and regression test, What is a test case? How to manage test cases? Test procedure, Equivalence classes and boundary conditions, How to allocate test time among system components based on test type (feature test, regression test, load test) and operation modes? In what order the test should be carried on? Running a successful test, How is to document the execution results?

**UNIT-IV** **9L**

**Applying failure data to guide decisions**: Guiding decisions related to certification test, Guiding decisions related to reliability growth test, Guiding decisions related to adequacy of tests, Handling program evolution, reported failures and variations of operational profiles.
**Deploying software reliability engineering**: Software Quality System (SQS); Software Quality Assurance (SQA) and Software Reliability Engineering (SRE) , Quality, test and data plans, Roles and responsibilities, Sample quality and test plan, Defect reporting procedure

**TEXTBOOKS**


1. John D. Musa, "*Software Reliability Engineering: More Reliable Software Faster and Cheaper*" , Authorhouse, 2nd edition, 2004.
2. Stephen H. Kan, "*Metrics and Models in Software Quality Engineering*", 2nd ed., Addison-Wesley Professional (2002).
3. Michael R. Lyu, "*Handbook of Software Reliability Engineering*", McGraw Hill (1996).
4. , J.D. Musa, A. Iannini, K. Okumoto, *"Software Reliability: Measurement, Prediction and Application"*, McGraw-Hill (1987).

**ICS-405** **Software Verification & Validation**

| | |
|---|---|
| Course category: | Industrial Elective # (IE#) |
| Pre-requisite Subject: | NIL |
| Contact hours/week: | Lecture: 3, Tutorial: 1, Practical: 0 |
| Number of Credits: | 4 |
| Course Assessment methods: | Continuous Assessment through Two Tests, Teacher Assessment (Quiz, Tutorial, Assignment, Attendance), and One Major Theory Examination. |

**Course Objective:** Software Verification and Validation is a very important step towards better software quality. It covers in detail the entire process of Software Testing which including S/w verification and validation. It also exposes students to latest S/w testing techniques and tools.

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

1. Understand the concepts and theory related to software testing.
2. Understand different testing techniques used in designing test plans, developing test suites, and evaluating test suite coverage
3. Understand the relationship between black-box and white-box testing and know how to apply as appropriate.
4. Learn to use automated testing tools in order to measure code coverage.
5. Understand how software developers can integrate a testing framework into code development to incrementally develop and test code.
6. Use testing frameworks and testing tools.

**UNIT-I** **9L**

An Introduction to Software Verification and Validation/Basic Concepts, Methods for Evaluating Software for Correctness and Reliability including Code, Inspections, Program Proofs, System Test Categories, Code inspections and their role in software verification.

**UNIT-II** **9L**

Review of Software Engineering Methods and Challenges, Role of Verification and Validation. Economics of Verification and Validation, Software Reviews and Inspections, Conducting Reviews and Inspection, Software Quality Metrics

**UNIT-III** **9L**

Review of Software Configuration Management, Software Testing Overview, Functional & Structural Testing, Integration and System Testing

**UNIT-IV** **9L**

Software validation metrics, Assessing and Improving the Validation Process, Improving the development Process

**Textbooks:**


30. Stephen H Kan, Metric and Model in Software Quality Engineering, Pearson Education
31. William Perry, Effective methods for Software Testing, Wiley Publication
32. Dorotny Graham, Erik Van Veenendaal, Foundation of Software Testing By: CENGAGE learning
33. Dr. K.V.K. Prasad, Software Testing Tools, Dreamtech Press
34. *Pankaj Jalote,* An Integrated Approach To *Software* Engineering, Springer Verlag, NY, 1991
35. Rajib Mall, Fundamentals of Software Testing, PHI Publication


**ICS- 406 Modelling and Simulation**

| | |
|---|---|
| **Course Category** | Industrial Elective # (IE#) |
| **Pre-requisite Subject** | NIL |
| **Contact Hours/Week** | Lecture: 3, Tutorial: 1 & Practical: 0 |
| **Number of Credits** | 4 |
| **Course Assessment Methods** | Continuous Assessment through Two Tests, Teacher Assessment (Quiz, Tutorial, Assignment, Attendance), and One Major Theory Examination. |

**Course Objective:** The objective of this course is to introduce simulation and modelling, with an emphasis on the simulation approach.

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

1. formulate a mathematical model describing a physical phenomenon
2. to discretize the model
3. design and analysis of numerical algorithms for solving equations resulting from discretization
4. implementation of numerical algorithms
5. performance of numerical experiments
6. scientific visualization of the data and computational simulation using OpenGL

**TOPIC COVERED**

**UNIT-I** **9L**

Introduction: Definition of system, model, and simulation, trade-offs, and conceptual stages of the simulation modelling enterprise, When simulation is the appropriate tool and when it is not appropriate? Advantages and disadvantages of Simulation; Areas of application, Systems and system environment; Components of a system; Discrete and continuous systems, Model of a system

Reviews system theoretic concepts: discrete event simulation (DES), state, events, simulation clock, and event list

**UNIT-II** **9L**

Probability and Statistics: information on the elements of probability, statistics, and stochastic processes that are relevant to simulation modelling, Queuing Models: Characteristics of queuing systems, Queuing notation, Long-run measures of performance of queuing systems, Long-run measures of performance of queuing systems
Random Number and variate: random number and random variate generation

**UNIT-III** **9L**

Input analysis: distribution fitting and the corresponding input analyzer tool of Arena
Output Analysis: replication design, estimation, and experimentation for both terminating and steady state simulations and the corresponding Arena

**UNIT-IV** **9L**

**VERIFICATION AND VALIDATION**

Model Building – Verification of Simulation Models – Calibration and Validation of Models – Validation of Model Assumptions – Validating Input – Output Transformations

Simulation Tools – Model Input – High level computer system simulation – CPU – Memory Simulation – Comparison of systems via simulation – Simulation Programming techniques – Development of Simulation models.

**TEXTBOOKS**


1. Theory of Modeling & Simulation, 2 nd Ed., B.P. Zeigler, H. Praehofer, T.G. Kim, 2000
2. Developing Component-based Simulation Models, B.P. Zeigler and H.S. Sarjoughian (available from Blackboard)
3. Francois E. Cellier and Ernesto Kofman, “Continuous System Simulation,” Springer-Verlag New York, Inc. Secaucus, NJ, USA, 2006
4. Gordon G.: System Simulation" , Prentice-Hall of India Pvt. Ltd. New Delhi 1993.
5. Narsingh Deo: System Simulation with Digital Computer:, PHI New Delhi, 1993
6. Neelamkavil Frances: "Computer Simulation and modelling, John Wiley & Sons,NewYork 1987,
7. Payne, James A.: " Introduction to Simulation: Programming Techniques and Methods of Analysis, McGraw-Hill International Editions, Computer Science Services, New York (1998).
8. Reitman Julian: "Computer Simulation Experiments", Wiley- Interscience, 1971.


**OCS-401** **Python Programming**

| | |
|---|---|
| Course category: | Open Elective (OE) |
| Pre-requisite Subject: | NIL |
| Contact hours/week: | Lecture: 2, Tutorial: 1, Practical: 0 |
| Number of Credits: | 3 |

| | |
|---|---|
| Course Assessment methods: | Continuous Assessment through Two Tests, Teacher Assessment (Quiz, Tutorial, Assignment, Attendance), and One Major Theory Examination. |

**Course Objective:** It contains a basic introduction to familiarize students with the basics of Python Language. Here are the key objectives covered in this covered.

1. Build basic programs using fundamental programming constructs like variables, conditional logic, looping, and functions.
2. Work with user input to create fun and interactive programs.
3. Create simple games with images, animations, and audio using our custom beginner-friendly programming library

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

1. Able to apply the principles of python programming.
2. Write clear and effective python code.
3. Create applications using python programming.
4. Access database using python programming.
5. Develop web applications using python programming.
6. Develop and use Web Services using python.

**UNIT-I** **6L**

**Introduction to Python Programming Language-** Strengths and Weaknesses, IDLE, Dynamic Types, Naming Conventions, String Values, String Operations, String Slices, String Operators, Numeric Data Types, Conversions, Built in Functions.

**Data Collections and Language Component-**Introduction, Control Flow and Syntax, Indenting, if Statement, Relational Operators, Logical, Operators, True or False, Bit Wise Operators, while Loop, break and continue, for Loop, Lists, Tuples, Sets, Dictionaries, Sorting Dictionaries, Copying Collections.

**UNIT-II** **6L**

**Object and Classes-**Classes in Python, Principles of Object Orientation, Creating Classes, Instance Methods, File Organization, Special Methods, Class Variables, Inheritance, Polymorphism, Type Identification, Custom Exception Classes

**UNIT-III** **6L**

**Functions and Modules-**Introduction, Defining Own Functions, Parameters, Function Documentation, Keyword and Optional Parameters, Passing Collections to a Function, Variable Number of Arguments, Scope, Functions - "First Class Citizens", Passing Functions to a Function, Mapping Functions in a Dictionary, Lambda Modules, Standard Modules – sys, Standard Modules – math, Standard Modules – time, The dir Function

**UNIT-IV** **6L**

**I/O and Error Handling in Python**-Introduction, Data Streams, Creating Own Data Streams, Access Modes, Writing Data to a File, Reading Data from a File, Additional File Methods, Using Pipes as Data Streams, Handling IO Exceptions, Working with Directories, Metadata, Errors, Run Time Errors, The Exception Model, Exception Hierarchy, Handling Multiple Exceptions

**EXPERIMENTS**

1. Write python program to print "Hello World".
2. Write python program to Hello World using string variable
3. Write python program to store data in list and then try to print them.
4. Write python program to do basic trim and slice on string.
5. Write python program to print list of numbers using range and for loop
6. Write python program to store strings in list and then print them.
7. Write python program to let user enter some data in string and then verify data and print welcome to user.
8. Write python program in which a function is defined and calling that function prints Hello World
9. Write python program in which a function (with single string parameter) is defined and calling that function prints the string parameters given to function.
10. Write python program in which a class is define, then create it.

**Textbooks:**


1. Dive into Python, Mike
2. Learning Python, 4th Edition by Mark Lutz
3. Programming Python, 4th Edition by Mark Lutz

# Syllabus of Audit Courses

# CONSTITUTION OF INDIA

**Course Code:** : **AUC 01** **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 OUTCOME:**
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 02** **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 03** **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 outcome**
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 Budhdhist 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 lats, eddicts, 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 Orrisan 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.

**REFERNCE 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. Volwahsen, 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 04** **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 05 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) , Aryabhatt , Brahmagupt , 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, Chokhambba Vidya Bhavan, Varanasi.

6. Bharatiya Mathematicians, Sharda Sanskrit Sansthan, Varanasi.

# ASTRONOMY

**Course Code:** : **AUC 06** **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 – Aryabhatta, 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:**

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


## ARTS OF INDIA

**Course Code:** : **AUC 07** **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 08** | **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 09** | **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

**Course Code:** : **AUC 10** **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 outcome:** 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 11** **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 12** **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 nded, Oxford University Press, 2014)
2) P. Leelakrishnan, Environmental law in India (4th 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 (3rd ed., Oxford University Press, 2009)
6) Philippe Sands, Principles of International Environmental Law (2nd ed, Cambridge University Press, 2003)

# HEALTH LAW

**Course Code:** : **AUC 13** **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 Outcome:** 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)

**Course Code:** : **AUC 14** **Credits (0-0-0)**
**Course Category** : **Audit**
**Pre-requisite Subject** : NIL
**Contact Hours/Week** : ½ Lecture : , Tutorial : , Practical:

**Number of Credits** : 0 Credit

**Course Outcome:** 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" 1st Edition (English, Paperback, RPH Editorial Board)

## Basics of Human Health and Preventive Medicines

| | | | |
|---|---|---|---|
| **Course Code:** | **:** | **AUC 15** | **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- 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" 5th 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" 4th Edition, Japee

# Detail Syllabus of Extra Curricular Activities (ECA) Courses under Council of Student Activities

## Skill Development- I (ECA-151)

| | | |
|---|---|---|
| Course Category | : | Extra-Curricular Activities |
| Pre-Requisite | : | NIL |
| Contact/Hours of Work | : | 2 Hours/Week |
| Number of Credits | : | 0 |
| Course Assessment Method | : | Practical Participation and Training |
| Course Outcome | : | Students are expected to learn and develop their skill and their personality through the activities and trainings under the council and should be well versed with the listed activities and events. |

**UNIT- 1**

- **Introduction to TSC and IEEE:** An introduction to technical sub-council and IEEE. An overview of IEEE and the events conducted by them.

**UNIT- 2**

- **Robotics Classes:** Informative classes conducted on by the students of IEEE about Bot modelling and electronics as well as embedded. It is conducted for both Wired and Wireless Robotics.

**UNIT- 3**

- **Introduction to Workshops by IEEE:** *Workshop* is a brief intensive course for a small group which emphasizes problem solving. A number of workshops are conducted by IEEE like Ethical hacking, Soft skills, Artificial Intelligence etc.

**UNIT- 4**

- **Events under TechSrijan:** Techsrijan is the annual techno-management fest held every year like Enigma, Robotics, Incognito, Quizzes, World Parliament, etc.

## Skill Development- II (ECA-201)

| | | |
|---|---|---|
| Course Category | : | Extra-Curricular Activities |
| Pre-Requisite | : | NIL |
| Contact/Hours of Work | : | 2 Hours/Week |
| Number of Credits | : | 0 |
| Course Assessment Method | : | Practical Participation and Training |
| Course Outcome | : | Students are expected to learn and develop their skill and their personality through the activities and trainings under the council and should be well versed with the listed activities and events. |

**UNIT- 1**

- **Introduction to TSC and SAE:** An introduction to technical sub-Council and SAE. An overview of SAE and the events conducted by them.

**UNIT- 2**

- **Aeromodelling Classes:** Informative classes and workshop conducted on by the students of SAE about Drone and remote-controlled modeling and electronics as well as embedded.

**UNIT -3**

- **Introduction to Workshops by SAE:** *Workshop* is a brief intensive course for a small group which emphasizes problem solving. A no. of workshops is conducted by SAE like Aeromodelling workshop, Bridge modeling etc.

**UNIT- 4**

- **Events under TechSrijan by SAE:** Techsrijan is the annual techno-management fest held every year. SAE conducts a number of events in TechSrijan like Junkyard Wars, Bride Kriti, El Tiro etc.

## Skill Development- III (ECA-251)

| | | |
|---|---|---|
| Course Category | : | Extra-Curricular Activities |
| Pre-Requisite | : | NIL |
| Contact/Hours of Work | : | 2 Hours/Week |
| Number of Credits | : | 0 |
| Course Assessment Method | : | Practical Participation and Training |
| Course Outcome | : | Students are expected to learn and develop their skill and their personality through the activities and trainings under the council and should be well versed with the listed activities and events. |

**UNIT- 1**

- **Introduction to TSC and UIC:** The University Innovation Cell supports and provides opportunity for Innovation works. You will get to learn about the things they do and promote.

**UNIT -2**

- **Introduction to Innowizion:** Every year University Innovation Cell organizes a national level event that provides opportunities for students across all disciplines to team up and use their creativity, passion, and knowledge of technology. Events like I-Expo and I-Quiz.

**UNIT- 3**

- **Introduction to Spectra:** It is a special event organized by University Innovation Cell which foster an opportunity for students to showcase their creativity and talent. It comprises of three events InQUIZitive, Replica and MindBuzz**.**

**UNIT- 4**

- **Learnings and Innovation:** Innovation increases your chances to react to changes and discover new opportunities. It can also help foster competitive advantage as it allows you to build better products and services for your customers in the industry.

## Skill Development- IV (ECA-301)

| | | |
|---|---|---|
| Course Category | : | Extra-Curricular Activities |
| Pre-Requisite | : | NIL |
| Contact/Hours of Work | : | 2 Hours/Week |
| Number of Credits | : | 0 |
| Course Assessment Method | : | Practical Participation and Training |
| Course Outcome | : | Students are expected to learn and develop their skill and their personality through the activities and trainings under the council and should be well versed with the listed activities and events. |

**UNIT- 1**

- **Introduction to TSC and SEB:** The Social Engineers Board (SEB) tries to achieve its goals by series of various events conducted throughout the academic year, both inside and outside the university.The members of the board are highly motivated individuals striving for noble cause, and voluntarily take initiatives which ensure betterment of the people and society in any way possible.

**UNIT- 2**

- **Introduction to Drishya:** A career counselling event by college final year, and an event designed to crave out the creativity inside the students and their ability to make something novel out of normality in situation

**UNIT- 3**

- **Introduction to Dhishan:** Bringing out the oration skill and leadership personality among the students by providing them chance to stand and represent themselves by this event.

**UNIT -4**

- **Introduction to Paravartan and NGOs:** Paravartan consists of a audio visual round and the second round is a skit presentation developing character of a student. They also collab with NGOs for social works.

## Skill Development- Vth (ECA-351)

| | | |
|---|---|---|
| Course Category | : | Extra-Curricular Activities |
| Pre-Requisite | : | NIL |
| Contact/Hours of Work | : | 2 Hours/Week |
| Number of Credits | : | 0 |
| Course Assessment Method | : | Practical Participation and Training |
| Course Outcome | : | Students are expected to learn and develop their skill and their personality through the activities and trainings under the council and should be well versed with the listed activities and events. |

**UNIT- 1**

- **Introduction to TSC and E CELL:** E-Cell of Madan Mohan Malaviya University of Technology promotes entrepreneurship abilities among the students of the university and conducts events to promote these ideas.

**UNIT- 2**

- **Introduction to Fresher's Talk:** A creative talk with the freshers of our university in which the fresher students provide some insights of what and how are they feeling about the college and its environment.

**UNIT- 3**

- **Introduction to Start Up Week:** Understanding the aspects of and entrepreneurial background and train to become one, through various personality developing as well as professionally balanced events.

**UNIT- 4**

- **Entrepreneurship Development:** It is the process of enhancing the skillset and knowledge of entrepreneurs regarding the development, management and organization of a business venture while keeping in mind the risks associated with it. Students will learn and cultivate skills which will promote entrepreneurship.

## Skill Development-VIth (ECA-401)

| | | |
|---|---|---|
| Course Category | : | Extra-Curricular Activities |
| Pre-Requisite | : | NIL |
| Contact/Hours of Work | : | 2 Hours/Week |
| Number of Credits | : | 0 |
| Course Assessment Method | : | Practical Participation and Training |
| Course Outcome | : | Students are expected to learn and develop their skill and their personality through the activities and trainings under the council and should be well versed with the listed activities and events. |

**UNIT- 1**

- **Introduction to TSC and Robotics Club:** Robotics Club speaks a name for itself in this domain with a sheen of itself that has been set by the high standards of the club members and strict adherence to the tagline Transforming ideas into reality, Events Details

**UNIT- 2**

- **Introduction to Web D Classes:** Classes on web development helps students to develop skills like Front-end and Back-end development which they can use to make websites.

**UNIT -3**

- **Introduction to Engineers Week:** a seven-day event paying tribute to all the engineers across the globe by conducting a no. of exciting events for technical development of students.

**UNIT- 4**

- **Robomania:** Develop the knowledge of robotics and circuitry in the students through training of students on circuits and the conduction of Robo Wars, Electronic chess, diffusion of a bomb in a set up made by students, demonstration of live game of the virtual events of NFS and Tekken, Lazer strike, Designing of Lazer maze.

## Unity and Discipline (NCC)-I (ECA-171)

| | | |
|---|---|---|
| Course Category | : | NCC |
| Pre Requisite | : | NIL |
| Contact/Hours of Work | : | 2 Hours/Week |
| Number of Credits | : | 0 |
| Course Assessment Method | : | Lecture & Practical |
| Course Outcome | : | After completing this course, the students will be able to: |

- Imbibe the conduct of NCC cadets.
- Do the social services on different occasions.

**UNIT -1**
**Introduction of NCC**: History, Aims, Objective of NCC.

**UNIT -2**
NCC as Organization. Incentives of NCC, Duties of NCC Cadet.
**UNIT -3**
Celebration of Days of National & International Importance, Social Service and Community Development Activities
**UNIT- 4**
NCC Parade on Independence Day.

## Unity and Discipline (NCC)-II – (ECA- 221)

| | | |
|---|---|---|
| Course Category | : | NCC |
| Pre Requisite | : | NIL |
| Contact/Hours of Work | : | 2 Hours/Week |
| Number of Credits | : | 0 |
| Course Assessment Method | : | Lecture & Practical |
| Course Outcome | : | After completing this course, the students will be able to: - |

- Respect the diversity of different Indian culture.
- Do the social services on different occasions.

**UNIT- 1**
National Integration & Awareness, Importance & Necessity

**UNIT- 2**
Factors Affecting National Integration, Unity in Diversity

**UNIT -3**
Celebration of Days of National & International Importance, Social Service and Community Development Activities
**UNIT- 4**
NCC Parade on Republic Day.

## Unity and Discipline (NCC)-III – (ECA-271)

| | | |
|---|---|---|
| Course Category | : | NCC |
| Pre Requisite | : | NIL |
| Contact/Hours of Work | : | 2 Hours/Week |
| Number of Credits | : | 0 |
| Course Assessment Method | : | Lecture & Practical |
| Course Outcome | : | After completing this course, the students will be able to: - |

- Perform his/her role in Nation Building.
- Do the social services on different occasions.

**UNIT- 1**
Role of NCC in Nation Building.

**UNIT- 2**
Threats to National Security.

**UNIT -3**
Celebration of Days of National & International Importance, Social Service and Community Development Activities

**UNIT- 4**
NCC Parade on Independence Day.

## Unity and Discipline (NCC)-IV- (ECA-321)

| | | |
|---|---|---|
| Course Category | : | NCC |
| Pre Requisite | : | NIL |
| Contact/Hours of Work | : | 2 Hours/Week |
| Number of Credits | : | 0 |
| Course Assessment Method | : | Lecture & Practical |
| Course Outcome | : | After completing this course, the students will be able to: - |

- Contribute to environmental awareness and conservation activities.
- Develop Leadership Qualities.
- Do the social services on different occasions.

**UNIT -1**
Environmental Awareness and Conservation.

**UNIT -2**
Leadership Development: Important Leadership traits, Indicators of leadership.

**UNIT- 3**
Celebration of Days of National & International Importance, Social Service and Community Development Activities

**UNIT -4**
NCC Parade on Republic Day.

## National Service Scheme-I (ECA-172)

| | | |
|---|---|---|
| Course Category | : | Extra-Curricular Activities |
| Pre-Requisite | : | NIL |
| Contact/Hours of Work | : | 2 Hours/Week |
| Number of Credits | : | 0 |
| Course Assessment Method | : | Continuous assessment through National Service Scheme related tasks, participation in different events organized, attendance, home assignments. |
| Course Outcome | : | The students are expected to be able to demonstrate the following knowledge, skills and attitudes in achieving NSS motto after completing this course: |

- The Motto of NSS "Not Me but You", reflects the essence of democratic living and upholds the need for self-less service.
- NSS helps the students' development & appreciation to other person's point of view and also show consideration towards other living beings.
- The philosophy of the NSS is a good doctrine in this motto, which underlines on the belief that the welfare of an individual is ultimately dependent on the welfare of the society as a whole and therefore, the NSS volunteers shall strive for the well-being of the society.

**Introduction to National Service Scheme:**

**UINIT-I:** History and its Objectives
**UNIT-II:** Organizational structure of N.S.S. at National, State, University and College Levels

**UNIT-III:** Advisory committee and their functions with special reference to University CSA, Program officer, N.S.S. group leader and N.S.S. volunteers in the implementation**.**

**UNIT-IV:** Organization/ Participation in "Tree-Plantation Drive"

## National Service Scheme- II (ECA-222)

| | | |
|---|---|---|
| Course Category | : | Extra-Curricular Activities |
| Pre-Requisite | : | NIL |
| Contact/Hours of Work | : | 2 Hours/Week |
| Number of Credits | : | 0 |
| Course Assessment Method | : | Continuous assessment through National Service Scheme related tasks, participation in different events organized, attendance, home assignments. |
| Course Outcome | : | The students are expected to be able to demonstrate the following knowledge, skills and attitudes in achieving NSS motto after completing this course: |

- The Motto of NSS "Not Me but You", reflects the essence of democratic living and upholds the need for self-less service.
- NSS helps the students' development & appreciation to other person's point of view and also show consideration towards other living beings.
- The philosophy of the NSS is a good doctrine in this motto, which underlines on the belief that the welfare of an individual is ultimately dependent on the welfare of the society as a whole and therefore, the NSS volunteers shall strive for the well-being of the society.

**UNIT-I:** National Integration, Need and importance of National integration

**UNIT-II:** Various obstacles in the way of National Integration, such as caste, religion, language and provisional problems etc.

**UNIT-III:** NSS related Activities: Awareness to various activities under NSS.

**UNIT-IV:** Organization/Participation in "Cleanliness Drive" at home, hostel, Department and University

**UNIT-V:** Organization/Participation in "Winter cloth collection and distribution to needy people"

## National Service Scheme- III (ECA-272)

| | | |
|---|---|---|
| Course Category | : | Extra-Curricular Activities |
| Pre-Requisite | : | NIL |
| Contact/Hours of Work | : | 2 Hours/Week |
| Number of Credits | : | 0 |

Course Assessment Method : Continuous assessment through National Service Scheme related tasks, participation in different events organized, attendance, home assignments.

Course Outcome : The students are expected to be able to demonstrate the following knowledge, skills and attitudes in achieving NSS motto after completing this course:

- The Motto of NSS "Not Me but You", reflects the essence of democratic living and upholds the need for self-less service.
- NSS helps the students' development & appreciation to other person's point of view and also show consideration towards other living beings.
- The philosophy of the NSS is a good doctrine in this motto, which underlines on the belief that the welfare of an individual is ultimately dependent on the welfare of the society as a whole and therefore, the NSS volunteers

shall strive for the well-being of the society.

**UNIT-I: Special Programme in NSS-I**

A) Legal awareness
B) Health awareness
C) First-aid

**UNIT-II: Special Programme in NSS-II**

A) Career guidance
B) Leadership training-cum-Cultural Programme
**C)** Globalization and its Economic Social Political and Cultural impacts.

**UNIT-III: Special Camping programme in NSS-I**

A) Nature and its objectives
B) Selection of campsite and physical arrangement
**C)** Organization of N.S.S. camp through various committees and discipline in the camp.

**UNIT-IV: Special Camping programme in NSS-I**

A) Activities to be undertaken during the N.S.S. camp.
**B)** Use of the mass media in the N.S.S. activities.

## National Service Scheme- IV (ECA-322)

| | | |
|---|---|---|
| Course Category | : | Extra-Curricular Activities |
| Pre-Requisite | : | NIL |
| Contact/Hours of Work | : | 2 Hours/Week |
| Number of Credits | : | 0 |
| Course Assessment Method | : | Continuous assessment through National Service Scheme related tasks, participation in different events organized, attendance, home assignments. |
| Course Outcome | : | The students are expected to be able to demonstrate the following knowledge, skills and attitudes in achieving NSS motto after completing this course: |

- The Motto of NSS "Not Me but You", reflects the essence of democratic living and upholds the need for self-less service.
- NSS helps the students' development & appreciation to other person's point of view and also show consideration towards other living beings.
- The philosophy of the NSS is a good doctrine in this motto, which underlines on the belief that the welfare of an individual is ultimately dependent on the welfare of the society as a whole and therefore, the NSS volunteers shall strive for the well-being of the society.

**UNIT-I: N.S.S. Regular Activities-I**

A) Traffic regulation
B) Working with Police Commissioner's Office
C) Working with Corporation of Gorakhpur District

**UNIT-II: N.S.S. Regular Activities-II**

A) Working with Health Department
B) Blind assistance
**C)** Garments collection and distribution

**UNIT-III: N.S.S. Regular Activities-III**

A) Non-formal Education
B) Environmental Education Awareness and Training (EEAT)'
**C)** Blood donation

**UNIT-IV: N.S.S. Regular Activities-IV**

A) Adopted Village related works
**B)** Disaster/Pandemic management

## GAMES & SPORTS-I (ECA-181)

| | | |
|---|---|---|
| Course Category | : | Extra-Curricular Activities |
| Pre-Requisite | : | Physical Education at 12th standard |
| Contact/Hours of Work | : | 2 Hours/Week |
| Number of Credits | : | 0 |
| Course Assessment Method | : | Practical Training and Practices. |
| Course Outcome | : | The students are expected to be able to perform the following Knowledge, skills, and attitudes after completing this course.<br>• Understand the concept of skill.<br>• Acquire the required motor skills.<br>• Demonstrate and assess various techniques of starts and finish.<br>• Interpret the rules & regulations.<br>• Acquire skill of marking track. |

**Track & Field-**

**UNIT- 1**

- **INTRODUCTION:**

Historical development

- National
- International

Structure and functions of Controlling Bodies

- National
- International

**UNIT- 2**

- **FUNDAMENTAL SKILLS:**

- Starting techniques: Standing start, Crouch start and its variations, Proper use of blocks.
- Finishing Techniques: Run, Through, Forward lunging, Shoulder Shrug.

**UNIT- 3**

- **FUNDAMENTAL SKILLS-II:**

- Various patterns of Baton Exchange.
- Understanding of Relay Zones.
- Rules & their interpretation.

**UNIT- 4**

- **FUNDAMENTAL SKILLS-III:**

- Drills and Lead-up Games.
- Marking and Layout of Track & Field

**Books & References**

1. Latest Official Rule Books of International Federation
2. Coaching Manuals of International Federation
3. Official Website

## GAMES & SPORTS-II (ECA-231)

| | | |
|---|---|---|
| Course Category | : | Extra-Curricular Activities |
| Pre-Requisite | : | Physical Education at 12th standard |
| Contact/Hours of Work | : | 2 Hours/Week |
| Number of Credits | : | 0 |
| Course Assessment Method | : | Practical Training and Practices. |
| Course Outcome | : | The students are expected to be able to perform the following Knowledge, skills and attitudes after completing this course. |

- Understand the concept of skill.
- Acquire the required motor skills.
- Demonstrate and assess various techniques of starts and finish.
- Interpret the rules & regulations.
- Acquire skill of marking track.

**Basketball-**

**UNIT- 1**

- **INTRODUCTION:**

Historical development

- National
- International

Structure and functions of Controlling Bodies

- National
- International

**UNIT- 2**

- **FUNDAMENTAL SKILLS- I:**

- Player stance and ball handling.
- Passing-Two Hand chest pass, Two hand Bounce Pass, One Hand Baseball pass, Side Arm Pass, Over Head pass, Hook Pass.
- Receiving-Two Hand receiving, One hand receiving, Receiving in stationary position, Receiving while jumping, Receiving while running.

**UNIT- 3**

- **FUNDAMENTAL SKILLS- II:**

- Dribbling-How to start dribble, how to drop dribble, High dribble, Low dribble, Reverse dribble, Rolling dribble.
- Shooting-Lay-up shot and its variations, one hand set shot, one hand jump shot, Hook shot, and Free throw.
- Individual Defensive-Guarding the man with and without the ball, pivoting.

**UNIT- 4**

- **FUNDAMENTAL SKILLS-III:**

- Drills and Lead-up Games.
- Marking and Layout of Court.

**Books & References**

1. Latest Official Rule Books of International Federation
2. Coaching Manuals of International Federation
3. Official Website

## GAMES & SPORTS-III (ECA-281)

| | | |
|---|---|---|
| Course Category | : | Extra-Curricular Activities |
| Pre-Requisite | : | Physical Education at 12th standard |
| Contact/Hours of Work | : | 2 Hours/Week |
| Number of Credits | : | 0 |
| Course Assessment Method | : | Practical Training and Practices. |
| Course Outcome | : | The students are expected to be able to perform the following Knowledge, skills and attitudes after completing this course.<br>• Understand the concept of skill.<br>• Acquire the required motor skills.<br>• Demonstrate and assess various techniques of starts and finish.<br>• Interpret the rules & regulations.<br>• Acquire skill of marking track |

**Volleyball-**

**UNIT- 1**

- **INTRODUCTION:**

Historical development
- National
- International

Structure and functions of Controlling Bodies
- National
- International

**UNIT- 2**

- **FUNDAMENTAL SKILLS-I:**
- Service-Under Arm Service, Tennis Service, Floating Service.
- Overhead finger pass.
- The Dig (Under Arm pass).

**UNIT- 3**

- **FUNDAMENTAL SKILLS –II:**
- Back court defense.
- Defensive and Offensive strategies.
- Smash
- Block–individual and team.

**UNIT- 4**

- **FUNDAMENTAL SKILLS-III:**
- Drills and Lead-up Games.
- Marking and Layout of Field.

**Books & References**

1. Latest Official Rule Books of International Federation
2. Coaching Manuals of International Federation
3. Official Website

## GAMES & SPORTS-IV (ECA-331)

| | | |
|---|---|---|
| Course Category | : | Extra-Curricular Activities |
| Pre-Requisite | : | Physical Education at 12th standard |
| Contact/Hours of Work | : | 2 Hours/Week |
| Number of Credits | : | 0 |
| Course Assessment Method | : | Practical Training and Practices. |
| Course Outcome | : | The students are expected to be able to perform the following Knowledge, skills and attitudes after completing this course.<br>• Understand the concept of skill.<br>• Acquire the required motor skills.<br>• Demonstrate and assess various techniques of starts and finish.<br>• Interpret the rules & regulations.<br>• Acquire skill of marking track for running events. |

**Hockey-**

**UNIT-1**

- **INTRODUCTION:**

Historical development

- National
- International

Structure and functions of Controlling Bodies

- National
- International

**UNIT- 2**

- **FUNDAMENTAL SKILLS-I:**

- Player stance & Grip,
- Rolling the ball, Dribbling.
- Push, Stopping.
- Hit, Flick, Scoop.
- Reverse hit.

**UNIT- 3**

- **FUNDAMENTAL SKILLS-II:**

- Passing–Forward pass, square pass, triangular pass, diagonal pass, return Pass.
- Goalkeeping–Hand defense, foot defense.
- Positional play in attack and defense.

**UNIT- 4**

- **FUNDAMENTAL SKILLS-III:**

- Drills and Lead-up Games.
- Marking and Layout of Court.

**Books & References**

1. Latest Official Rule Books of International Federation
2. Coaching Manuals of International Federation
3. Official Website

## GAMES & SPORTS- V (ECA- 381)

| | | |
|---|---|---|
| Course Category | : | Extra-Curricular Activities |
| Pre-Requisite | : | Physical Education at 12th standard |
| Contact/Hours of Work | : | 2 Hours/Week |
| Number of Credits | : | 0 |
| Course Assessment Method | : | Practical Training and Practices. |
| Course Outcome | : | The students are expected to be able to perform the following Knowledge, skills and attitudes after completing this course. |

- Understand the concept of skill.
- Acquire the required motor skills.
- Demonstrate and assess various techniques of starts and finish.
- Interpret the rules & regulations.
- Acquire skill of marking track for running events.

**UNIT 1**

- **YOGA- HOLISTIC HEALTH:**

 Health- Concept of Health, its importance in human life.
 Components of health.

**UNIT-II**

- **YOGA AND ITS IMPORTANCE:**

- Definition of Yoga.
- Importance of Yoga in daily life.
- Aims and Objective of yoga.
- Misconception of yoga.

**UNIT-III**

- **SURYA NAMASKAR:**

- Benefits of Surya Namaskar
- Practices of Surya Namaskar

**Unit- IV**

- **YOGA PRACTICES:**

 Asana- Meditative
  i) Sukhasana
  ii) Padmasana
  iii) Swastikasana
 Cultural- Trikonasana, Makarasana, Bhujangasana, Sarpasana, Dhanurasana.
 Pranayama- Yogic Breathing, Anulom-Vilom.

**Books & References**

1. Indra Devi, “Yoga For You”, Gibbs, Smith publishers, Salt Lake City, 2002 Domen& Publishers, New Delhi-2001.
2. Yoga se Arogya, Indian Yoga Society, Sagar.

## Games & Sports -VI (ECA- 431)

| | | |
|---|---|---|
| Course Category | : | Extra-Curricular Activities |
| Pre-Requisite | : | Physical Education at 12th standard |
| Contact/Hours of Work | : | 2 Hours/Week |
| Number of Credits | : | 0 |
| Course Assessment Method | : | Practical Training and Practices. |
| Course Outcome | : | The students are expected to be able to perform the following Knowledge, skills and attitudes after completing this course.<br>• Understand the concept of skill.<br>• Acquire the required motor skills.<br>• Demonstrate and assess various techniques of starts and finish.<br>• Interpret the rules & regulations.<br>• Acquire skill of marking track for running events. |

**UNIT- 1**

- **Badminton**

**INTRODUCTION:**

Historical development

- National
- International

Structure and functions of Controlling Bodies

- National
- International.

**UNIT-II**

- **FUNDAMENTAL SKILLS-I:**

- Racket parts, Racket grips, Shuttle (dimensions).
- The basics stances.
- Basic foot movements.

**UNIT-III**

- **FUNDAMENTAL SKILLS-II:**

- The basic strokes-Serves.
- Forehand-overhead and underarm.
- Backhand-overhead and underarm.
- Types of games-Singles, doubles, including mixed doubles.

**Unit- IV**

- **FUNDAMENTAL SKILLS-III:**

- Drills and Lead-up Games.
- Marking and Layout of Court.

**Books & References**

1. Latest Official Rule Books of International Federation
2. Coaching Manuals of International Federation
3. Official Website

## Culture, Art & Literary-I (ECA-182)

| | | |
|---|---|---|
| **Course category** | : | Cultural, Art &Literary |
| **Pre-requisite Subject** | : | NIL |
| **Contact hours/week** | : | 2 Hours/Week |
| **Number of Credits** | : | 0 |
| **Course Assessment Methods** | : | Practical Participation |
| **Course Outcomes** | : | Students are expected to develop their soft skills and their Personality through cultural and literary activities. |

**UNIT-1**

Workout, Warm up, Stretching, Introduction to various dance forms, Dance form – Bollywood, Footwork, Body Movement, Theatre History, Literature and Aesthetics, Introduction to Acting, Yoga(Breathing, Exercise, Voice Control and Sound Modulation).

**UNIT-2**

Introduction to music, Basic Terminologies related to music, Origin of sound, Historical study of musical terms, Basic Introduction to Fine Arts, Roll of FAC in cultural sub-council, Basics of Fine Arts and Types, File extension, Editing software, Resources for stock images and video.

**UNIT-3**

**MALVIKA**: Basic knowledge of designing software (I) : Adobe In Design ,Photoshop ,Notice Making, Article writing.

**UNIT-4**

**TIRESIA**: Basic knowledge of designing software (I): Adobe In Design, Photoshop, Interview skills, Vocabulary development, Knowledge about technical advancements, knowledge of campus activities.

## Culture, Art & Literary-II (ECA-232)

| | |
|---|---|
| **Course category** | : Cultural, Art &Literary |
| **Pre-requisite Subject** | : NIL |
| **Contact hours/week** | : 2 Hours/Week |
| **Number of Credits** | : 0 |
| **Course Assessment Methods** | : Practical Participation |
| **Course Outcomes** | : Students are expected to develop their soft skills and their personality through cultural and literary activities. |

**UNIT-1**

Intro to basics of sketching, Painting, Craft, Sculpturing.

Sketch-Tools of sketching, Types of Sketching- Pencil/ Pen/ Color Pencil/ Charcoal/ Graphite/Ink/ Chalk / Digital Sketch. History of Indian Music, About life and contributions of Indian Musician sand Musicologists.

Two forms of Indian Classical Music (Hindustani/Karnataka).

**UNIT-2**

Introduction to Theatre Technique and Design, Character Analysis and practical on principle of Stanislavski Method (relaxations, concentration of attention and emotion memory), Workout, Warm up, Stretching, Dance Form- Hip-Hop, Footwork, Body movement, Choreography, Equipment, Types of lenses, building web site using template.

**UNIT-3**

**ARUNODAY**: Development of thinking ability with JAM (Just a Minute), Word Building, Letter rearrangement, Knowledge of spellings, Syllables, Critical thinking skill development, Vocabulary development, Thought expressing skill development, public speaking skill development.

**UNIT-4**

**SPELLCZAR**: Word building, Vocabulary development, Decision making ability development, Coordination capabilities.

## Culture, Art & Literary-III (ECA-282)

| | | |
|---|---|---|
| **Course category** | : | Cultural, Art &Literary |
| **Pre-requisite Subject** | : | NIL |
| **Contact hours/week** | : | 2 Hours/Week |
| **Number of Credits** | : | 0 |
| **Course Assessment Methods** | : | Practical Participation |
| **Course Outcomes** | : | Students are expected to develop their soft skills and their personality through cultural and literary activities. |

**UNIT-1**

**Photo editing** (Photoshop)

**Ras**- (Sringar Ras, Hasya Ras, Rodra Ras, Karun Ras, Vir Ras, Adbhut Ras, Vibath Ras, Bhayanak Ras, Shaant Ras)

**UNIT-2**

Workout, Warmup, Stretching, Pranam, Types of classical dance forms and their outfits, Dance form-Kathak, Hand movements, Choreography, Basic knowledge of Talas for Instance Teental, Dadra and Kherwa, Practice of AUM and vocal exercises of sargam (sa, re, ga, ma, pa, dha, ni) of 45. Alankaras, Styles of Sketching-Line/ Hatching/Blending/Scribbles/Tattoo/Doodling/Cartoon/Graffiti/Typography/Calligraphy/Caricat Ure

**UNIT-3**

**ANNUAL DEBATE COMPETITION**: General Knowledge & Current Affairs, Public speaking skill development, Oratory skill development, Sense of Team spirit, Knowledge of language, Social Study, Development of presentation skills.

**UNIT-4**

**TWIST AND TWAIN**: Development of imaginative power and creativity, Development of vocabulary, Development of writing skills, Thinking skill development.

## Culture, Art & Literary-IV (ECA-332)

| | |
|---|---|
| **Course category** | : Cultural, Art &Literary |
| **Pre-requisite Subject** | : NIL |
| **Contact hours/week** | : 2 Hours/Week |
| **Number of Credits** | : 0 |
| **Course Assessment methods** | : Practical Participation |
| **Course Outcomes** | : Students are expected to develop their soft skills and their Personality through cultural and literary activities. |

**UNIT-1**

Video editing, Basic knowledge about musical instruments (Tabla, flute, guitar etc.) about Swarmalika and two bragas-Bhupaliand Yaman.

**UNIT-2**

Monologue, reciting a poem, reading short stories, developing speech skill, Mime, Working on scene with partner and in a group, Painting-Tools of painting, Styles of painting-Abstract/Imagination/Expression/Cubism/Indian/Chinese/Japanese, All the theory covered upto Praveshi ka Purna, define and explain Kataaksha,Primalu, Nartan Bhedas- Nritta Nrutya and Natya, define Tandav and Lasya, Fourty pesof neck movements according to Abhinaya Darpan, Eight types of eye movements according to Abhinaya Darpan, Define and differentiate "FolkDance" and "Modern Dance" (Uday Shankar style), Life story of: Bindadin Maharaj, Kalka Prasadji, Harihar Prasadji& Hanuman Prasadji, Specialty of Jaipur and Lucknow Gharana,Definition and uses of the following Asanyukta Hasta Mudras: Sarpsheersha, Murga-sheersha, Simha-Mukha, Kangula, Alapadma, Chatura, Bhrama, Hansasya, Hansa-paksha, Sandausha, Mukula, Tamrachuda, Vyagraha, Trishula, Sanyukta HastaMudra: Anjali, Kapota, Karkata, Swastik, Dola, Pushpaputa, Utsanga, Shivalinga, Katakawardhan, Kartari-swastk, Shakata, Shankha.

**UNIT-3**

**VAGMITA1**: Development of oratory skill, Development of poetry writing skill, Alankar, Ras, Creative thinking ability development.

**UNIT-4**

**VAGMITA 2**: How to overcome camera consciousness, enhancement of the expression and presentation of the participants, development of the public speaking skill, Knowledge of tone adjustment while presenting.

## Culture, Art & Literary-V (ECA-382)

| | | |
|---|---|---|
| **Course category** | : | Cultural, Art &Literary |
| **Pre-requisite Subject** | : | NIL |
| **Contact hours/week** | : | 2 Hours/Week |
| **Number of Credits** | : | 0 |
| **Course Assessment methods** | : | Practical Participation |
| **Course Outcomes** | : | Students are expected to develop their soft skills and their personality |

**UNIT-1**

Types of painting-Oil painting/ Watercolor painting/ Pastel painting/ Acrylic painting/ Digital painting/Spray Painting, Basic of Contemporary Dance, Foot Position and Transference, Center Technique, Travelling Technique, Dance, Dance (A) Peter Pan, dance (B) Emergence of a Butterfly.

**UNIT-2**

Improvisation, Elementary knowledge of Acting, Body language, Rhythm, Clarity and fluency in dialogue delivery, Understanding the depth of character, about terms related to Hindustani music like Naad, Shuruti, Saptak, Thaat, Vaadi, Samvadi, Photography Skill.

**UNIT-3**

**MALAVIYAN THINKER**: Creative thinking, how to pen down thoughts of our mind, Development of writing skill, Development of Expression, Public Speaking skill development.

**UNIT-4**

**ABHYUDAYA**: Multidimensional skill development: Technical skill development with software like Adobe Photoshop, MS word, MS PowerPoint, MS Excel, Content Writing skill development, public addressing, public engagement, Team work Mechanism, Leadership qualities, Time management, art and craft, Pottery, Oratory skill development, Presentation skill, Event management.

## Culture, Art & Literary-VI (ECA-432)

| | | |
|---|---|---|
| **Course category** | : | Cultural, Art &Literary |
| **Pre-requisite Subject** | : | NIL |
| **Contact hours/week** | : | 2 Hours/Week |
| **Number of Credits** | : | 0 |
| **Course Assessment methods** | : | Practical Participation |
| **Course Outcomes** | : | Students are expected to develop their soft skills and their personality |

**UNIT-1**

Cinematography, Basic knowledge of Thaat system, Raga formation rules, 5 Ragas- Bhupali, Yaman, Bihag, Kafi, Deskar.

**UNIT-2**

Introduction to Nukkad, Mono Act, Skit, Introduction to Comedy, Tragic Comedy, Tragedy, Melodrama, Craft- Tools of craft, Types of Craft- paperwork/ Wood work/ foam work/ Cloth work, Popping/ Introto music theory, Angles and Movement/Music Theory, Direction and Levels/Rhythms for Grooves, Twists and isolated movements/8 Count Phrasing, Footwork/Floats and Glides, Waves/Movements Dynamics, Waves 2/Musical Phrasing, Putting it all together.

**UNIT-3**

**WRITING SKILLS:** Invitation making, Notice making, Article writing.

**SKILL FOR INTEVIEWER**: How to take formal interview, approaching the personality, Questions preparation, management, platform selection, public engagement.

**UNIT-4**

**INTERVIEW SKILLS FOR INTERVIEWEE**: Body language, Attire, Hand gestures, voice tone, Language, General Interview Questions- How to introduce yourself.