Curriculum Structure & Syllabi

(As per National Education Policy 2020)

of

B. Tech.

in

Civil Engineering

(w.e.f. 2024-25)

Vision

Mission

Program Educational Objectives

Program Outcomes

Overall Credit Structure

Curriculum

Syllabus

Offered By

DEPARTMENT OF CIVIL ENGINEERING

MADAN MOHAN MALAVIYA UNIVERSITY OF TECHNOLOGY (MMMUT) GORAKHPUR-273 010, UP, INDIA

JULY 2024

ABOUT THE DEPARTMENT

The Civil Engineering was established in 1962, since the inception of erstwhile Madan Mohan Malaviya Engineering College, Gorakhpur. The department has, over the years, established its status as a centre for imparting high quality technical education to Undergraduate and Postgraduate students and extending consultancy services to industries and various government departments located in Eastern UP. Besides undergraduate course of (B.Tech.-Civil Engineering), the department offers 4 regular M. Tech. courses in Civil Engineering respectively in Hill Area Development Engineering, Environmental Engineering, Structural Engineering, and Seismic Design and Earthquake Engineering domains. The facilities of doctoral research are also available in the department under QIP/ TEQIP/ University schemes.

The department has experienced and highly qualified faculty members. Further, the strength of the department also lies in the strong linkages, it has with its alumni and various governments/private organizations located in the region. The alumni of the department are well placed in various government/private organizations and are in close contact with the department. The department is continuously interacting with the various government and private organization in the form of consultancy work, expert advice, design projects etc.

VISION:

To become a premier centre of learning and research in Civil Engineering, nurturing sustainable development by the year 2025.

MISSION:

1. To provide the quality education in the area of civil engineering to transform students into graduates with high professional values.

2. To share and disseminate expertise for use in the solution of problems faced by Civil engineering industry and by society.

3. To insure the continuous improvement in the quality of life of people in the society.

4. To conduct need based research base projects giving priority to the needs of industry.

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

PEO-1   To enrich the students with state-of-the-art knowledge in the field of Civil Engineering.

PEO-2   To keep abreast the students with the use of modern tools, equipment and software and inculcating the habit of life-long learning.

PEO-3   To foster teamwork and professional ethics among students towards devising feasible solutions to problems and project work.

Program Outcome (POs)

PO-1   Broadening the horizon of the students in the field of Civil Engineering, increasing their ability to apply knowledge of mathematics, science, and engineering to solve real world problems.

PO-2   Increasing the ability of students to identify, formulate and solve problems in a systematic way by appropriate collection, analysis, and interpretation of data.

PO-3   Increasing their ability to design a system, component, or process to meet the desired needs in an environment friendly and socially acceptable way.

PO-4   Enhancing their skills to analyze complex Civil Engineering problems and obtain the solution by synthesizing simple components.

PO-5   Increasing their ability to use the techniques, skills and modern engineering and Information Technology based tools (such as web-based applications and open-source software etc.) to increase the creativity of students.

PO-6   Enhancing awareness of students about the impact of engineering projects in a global and societal context (social, economic, legal and/or environmental implications).

PO-7   Enhancing their ability to practice environmental concerns and related sustainable measures and be capable of carrying out environmental impact of a civil engineering projects.

PO-8   Informing students about engineering ethics and professional responsibilities.

PO-9   Increasing their decision-making skills and innovative capability not only individually but also in a multi-disciplinary team.

PO-10   Increasing the ability to communicate effectively by enhancing their drawing and report writing skills and oral presentation skills.

PO-11   Increasing awareness of students about cost, time and quality issues in construction helping them to develop social and leadership skills.

PO-12   Providing the students with knowledge on contemporary issues in the field of civil engineering and recognizing the need for an ability to engage in continuous and life- long learning.

Program Specific Outcome (PSO):

PSO -1. To identify, analyze and suggest solutions for the issues faced by the present and future generation related to Civil Engineering fields.

PSO -2. Plan, analyze, and design infrastructural projects and its components in various areas of Civil Engineering like Structural Engineering, Geotechnical Engineering, Water Resources Engineering, Environmental Engineering, and Transportation Engineering.

PSO -3. Execute the construction of buildings and other components of various projects in Civil engineering including its layout, management, and quality control.

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

Credit Courses				
Core Courses (CC)			**Electives Courses (EC)**	
Category	**Min. Credits**		**Category**	**Min. Credits**
Basic Sciences & Maths (BSM)	20		Professional Electives (PE)/ Open Electives (OE)	36
Engineering Fundamentals (EF)	24			
Professional Skill (PS)				
Professional Core (PC)	48		Humanities & Social Science Elective (HSSE)	04
Management (M)	04			
Humanities & Social Science (HSS)	08			
Minor Project (P)	06			
Industrial Practice (IP) (In Industry)/ Major Project (MP) (In University)	10			
Sub-total	**120**		**Sub-total**	**40**
Grand Total	**160**			
Non-Credit Courses				
One Expert Lecture per semester for students (Mandatory). (BSM-Ist year), (PC-2nd Year), (T&P-3rd Year)				**Non-Credit**
Social work/Training of at least 60 hours during break after first/ second semester (Mandatory) (Dean of Extension, Field Outreach and Alumni Relations).				**Non-Credit**
Industrial Training during the summer break after fourth semester (Mandatory).				**Non-Credit**
One -week workshop during the winter break after fifth semester on professional/ industry/ Social/ entrepreneurial orientation (Mandatory) (Dean of Extension, Field Outreach and Alumni Relations).				**Non-Credit**
Value Added Courses (VAC) / Audit Courses (AC) Two of the Value-Added Courses / Audit Courses are compulsory.				**Non-Credit**
Extracurricular Activities Courses (ECA) Two compulsory courses from the following S. No (ii) to (v) non-credit courses: (i) Induction Program (compulsory) (ii) Skill development (iii) Unity and Discipline (NCC or NSS) (iv) Sports, Cultural and Games (v) Personality Development				**Non-Credit**
Minor Degree (MD) from any Department and Micro Specializations (MS) within the Department				
• The total number of credits for graduation will be kept to minimum 160. The additional 18-20 credits required for Minor Degree Courses. • Micro specializations (MS) will be run by the department in order to aligned to industry careers or higher studies				Offered as a Professional Electives (PE)

DEPARTMENT OF CIVIL ENGINEERING
MADAN MOHAN MALAVIYA UNIVERSITY OF TECHNOLOGY (MMMUT)
GORAKHPUR-273 010, UP, INDIA
SEMESTER WISE CREDIT STRUCTURE FOR B. TECH. CIVIL ENGINEERING

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

Minor variation is allowed as per need of the respective disciplines.

Curriculum for B.Tech. (Civil Engineering)

First Year, Semester I

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

 # Group-1: CSE, IT, CH, CE; Group-2: ECE, ECE(IOT), ME, EE.

First Year, Semester II

S. N.	Category	Paper Code	Subject	L	T	P	Credit
1.	BSM	BSM-160	Engineering Mathematics II	3	1	0	4
2.	BSM	BSM-140 /BSM-190	Environmental Science and Green Chemistry	3	0	2	4
3.	EF	BEE- 110 / BEE-160	Basic Electrical Engineering	3	0	2	4
4.	PS	BCE 161	Mechanics of Structures	2	0	4	4
5.	HSS	BHS-102 /BHS-152	Technical Writing and Professional Communication	3	1	0	4
			Total	**14**	**2**	**8**	**20**
	VAC/AC	BCE-162	Design Thinking in Civil Engineering	0	0	2	0
1.	ECA-II			-	-	-	**0**

List of Extra Curricular Activity (ECA) Courses

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

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

S. No.	Subjects	Codes
1.	Constitution of India	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

SKILLS-ENHANCEMENT COURSES FOR EXIT (CIVIL):

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

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

1. Plumbing and Sanitation.
2. Computer aided drafting.
3. Carpentry and fabrication.

OR

Equivalent skills-enhancement courses from MOOC/SWAYAM.

SYLLABI

Semester-I

BSM-110		**Engineering Mathematics I**
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. Understand the concepts of limit theory and nth order differential equations and their applications to our daily life
3. Solve linear system of equations using matrix algebra.
4. Know about qualitative applications of Gauss , Stoke's and Green's theorem.
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
Differential Calculus: Limit, Continuity and Differentiability, Mean value theorems. Leibnitz theorem, Partial derivatives, Euler's theorem for homogenous function, Total derivative, Change of

variable. Taylor's and Maclaurin's theorem. Expansion of function of two variables, Jacobian, Extrema of function of several variables.

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, Eigen-vectors, Cayley-Hamilton theorem, Diagonalization of matrices.

UNIT-III   9
Multiple Integrals: Double and triple integrals, change of order of integration, change of variables. Application of multiple integral to surface area and volume. Beta and Gamma functions, Dirichlet integral.

UNIT-IV   9
Vector Calculus: Gradient, Divergence and Curl. Directional derivatives, line, surface and volume integrals. Applications of Green's, Stoke's and Gauss divergence theorems (without Proofs).

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.,

BSM-131/181		**ENGINEERING PHYSICS**
Course category	:	Basic Sciences and Maths (BSM)
Pre-requisite Subject	:	Physics at 12thStandard
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 Examination
Course Objectives	:	Understanding of the principles and concept of Optics, Quantum Mechanics, Fiber Optics, Electrodynamics and Physics of Advanced Materials.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills, and attributes after completing this course.

1. Understand the basics principles of Optics and its applications in Engineering and Technology.
2. Compare and understand the uses of various lasers in different fields of Engineering.
3. Know the knowledge of Optical Fibre and their applications in Photonics.
4. Understand the principles of Quantum Mechanics and their applications in Engineering and Technology.
5. Know the principles of Electrodynamics and their applications in Engineering and Technology.
6. Understand the basic properties of advanced materials and their engineering applications.

UNIT-I: Optics: 9

Interference: Interference of light, Interference in thin films, Newton's rings. Refractive index and wavelength determination.

Diffraction: Fresnel and Fraunhofer class of diffraction. Resultant of n-hormonic waves, single, double and N- slit diffraction, Diffraction grating, Grating spectra, Dispersive power.

Polarization: Phenomena of double refraction, Nicol prism, Production and analysis of plane, circular and elliptical polarized light, Retardation Plate, Polarimeter.

Laser: Spontaneous and stimulated emission of radiation, Population inversion, Concept of 3 and 4 level Laser, Construction and working of Ruby, He-Ne lasers, and laser applications.

UNIT-II : Quantum Mechanics and Fiber Optics: 9

Quantum Mechanics: de Broglie waves, Davisson-Germer experiment, Concept of Phase and Group velocities, Uncertainty principle and its applications, Derivation of time independent and time dependent Schrodinger wave equations. Postulates of quantum mechanics, Significance of wave function, Application of Schrodinger wave equation for a particle in one dimensional infinite potential well.

Fiber Optics: Fundamentals of optical fiber, Acceptance angle and cone, Numerical aperture, Single and Multi-Mode Fibers, Step index and graded index fiber, Propagation Mechanism in optical fibers.

UNIT-III: Electrodynamics: 9

Scalar and Vector fields, Gradient, Divergence and curl, Concept of displacement current, Maxwell's equation in differential and integral forms, Physical significance of each equation.

Maxwell's equation in free space, Velocity of electromagnetic wave, Transverse nature of the electromagnetic wave, Poynting vector, Maxwell's equations in dielectric and conducting medium, and skin depth.

UNIT-IV: Physics of Advanced Materials: 9

Concept of energy bands in solids, Semiconducting materials**,** Concept of direct and indirect band gap in semiconductors, Carrier concentration and conductivity in semiconductors, Optoelectronic Materials, Superconducting Materials**,** Temperature dependence of resistivity in superconducting materials, Effect of magnetic field (Meissner effect), Type I and Type II superconductors, London Equations, BCS theory (Qualitative), Introduction of nanoscience, Nanotechnology and its applications.

EXPERIMENTS

1. To determine the specific resistance of a given wire using Carrey Foster's Bridge.

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

Books & References

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

11. Engineering Physics by H. K. Malik and A. Singh Tata MCGraw Hill.
12. Advanced Practical Physics Vol. I and Vol. II by D. K. Dwivedi, Victorius Publishers, New Delhi.

BIT-103   **PROGRAMMING IN C**

Course category   : Engineering Fundamentals (EF)
Pre-requisite Subject   : NIL
Contact hours/week   : Lecture: 3, Tutorial: 0, Practical:2
Number of Credits   : 4
Course Assessment Methods: Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce, Minor test and Major Theory Examination

Course Objective: Students will gain an understanding of the fundamentals of computers and programming. The objective is to prepare them for various dimensions of C Programming language.

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

1. Describing the basics of terminologies used in computer programming.
2. Practicing C language programming by writing, compiling and debugging the code.
3. Designing programs involving simple statements, conditional statements, iterative statements, array, strings, functions, recursion and structure.
4. Discussing the dynamic memory allocations and use of the pointers.
5. Applying basic operations on files through programs.
6. Studying and implementing the codes using macros, pre-processor directives and command line arguments

<div align="center">TOPICS TO BE COVERED</div>

UNIT-I   **09**
Basics of Computers and Programming: Functional diagram of computer; Language Processors; Approaches to problem solving, Concept of algorithm and flow charts. **Simple Statements:** Data types; Tokens and its types; Variable declaration and initialization; User defined type declaration: type def, enum; Comments; Format specifiers; Standard I/O: taking input and displaying output; **Operators:** types, precedence and associativity; Expressions; Type conversion, Cshort-hands.

UNIT-II   **09**
Conditional Statements: Simple if, if-else, nested if-else, else-if ladder, switch statements, nested switch, advantages of switch over nested if, restrictions on switch values. **Iterative Statements:** Concepts of entry and exit controlled loops; Uses of for, while and do while loops; Nested Loops; Printing various patterns using nested loops; Using break, continue and goto statements.

UNIT-III   **09**
Arrays: Single-dimensional, multi-dimensional array and their applications; declaration and manipulation of arrays; strings and string handling functions. **Pointers:** Pointer and address arithmetic; dereferencing; pointers and arrays; dynamic memory allocation and de-allocation. **Functions:** Function prototype; Arguments and its types: actual, formal and default arguments; Scope of a variable; Argument passing methods; Passing pointer as the function argument; Recursion: types, advantages and disadvantages; Storage class specifies; Character test functions.

UNIT-IV   **09**
Structure: Declaring and defining structures; Array within structure; Array of structure; Defining and using some data structures: Stack, Queue, and Linked lists. **File Handling:** Types of files; Text files and different operations on text files, opening a file, closing a file; Data structure of a file; EOF; I/O operations on files; Random access to the files. **Standard C Pre-processors & C Library:** Pre-

processor, Directives, Macro, Macro substitution; Conditional Compilation; Command Line Arguments; Standard C Library.

EXPERIMENTS

Implementing programs in following categories using programming language 'C':

1. Programs of simple statements, conditional statements, and iterative statements with the applications.
2. Programs of single and multi-dimensional arrays and their applications.
3. Programs of strings and the applications
4. Programs of pointer and the applications
5. Programs of function and the applications
6. Programs of structure and the   applications
7. Codes of file handling and management
8. Codes with Pre-processor, Macro, Conditional Compilation and Command Line Arguments

Textbooks
1. Brian W. Kernighan and Dennis M. Ritchie, "The C programming language", Pearson
2. E. Balagurusamy, "Programming in ANSI C", McGraw Hill Education
3. Yashavant Kanetkar, "Let Us C", bpb publication
4. Jeri R. Hanly, Elliot B. Koffman, "Problem Solving and Program Design in C", Pearson
5. Herbert Schildt,"C: The Complete Reference", McGraw Hill Education

BCE 101   ENGINEERING GRAPHICS

Course category	:	Engineering Fundamentals (EF)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture : 2, Tutorial : 0 , Practical: 4
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through attendance, home assignments, quizzes, practical work, record, viva voce, Two minor tests, One Major Theory Exam and major Practical Examination
Course Objectives	:	This course aims at the following educational objectives: Comprehend general projection theory, with emphasis on orthographic projection to represent three-dimensional objects in two-dimensional views (principal, auxiliary, sections). Dimension and annotate two-dimensional engineering drawings.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course 1.How Engineering Drawing helps to sketch the imagination? 2.Able to effectively practice the different scales for drawings. 3.Effectively analyze the geometrical shapes and to be able to draw. 4.Know about out solids and discuss about their classification. 5.How to implement the different views for a solid placed in 3dspace. 6.Construction of the object from different perspective.

Topics Covered

UNIT-I   **6**

Conic Sections and Orthographic Projections Introduction

Introduction to Engineering Drawing covering, Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales.

Orthographic Projections

Orthographic Projections covering Principles of Orthographic Projections- Conventions Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Plane

UNIT-II 6

Projection of Regular Solids

Projections of Regular Solids covering those inclined to both the Planes- Auxiliary Views

UNIT-III 6

Sections and Sectional Views of Right Angular Solids

Sections and Sectional Views of Right Angular Solids covering, Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone

UNIT-IV 6

Isometric Projections

Isometric Projections covering, Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions. Overview of computer graphics, demonstrating knowledge of the theory of CAD software.

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

Reference Books
1. Engineering Drawing and Computer Graphics- Shah, M.B. & B.C. Rana, Pearson Education, 2008
2. A Text Book of Engineering Drawing-Dhawan, R.K., S. Chand Publications,2007
3. Text book on Engineering Drawing-Narayana, K.L. & P Kannaiah, Scitech Publishers, 2008

Semester-II

BSM-160 **Engineering Mathematics II**
Course category : Basic Sciences & Maths (BSM)
Pre-requisite Subject : NIL
Contact hours/week : Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits : 4
Course Assessment methods : Continuous assessment through tutorials, attendance, home assignments, quizzes and 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 solve the ordinary differential equations.
2. To solve the partial differential equations using Lagrange and charpit's method.
3. To solve and understand the properties of Bessel`s and Legendre`s differential equation.
4. Application of partial differential equation in real life problems
5. To solve ODE and PDE with the help of Laplace transform
6. To inculcate the habit of mathematical thinking and lifelong learning.

Topics Covered

UNIT-I 9

Ordinary Differential Equations I: Linear differential equations with constant coefficients ($n^{th} order$), complementary function and particular integral. Simultaneous linear differential equations, solution of second

order differential equations by changing dependent and independent variables, Method of variation of parameters, Applications of differential equations to engineering problems

UNIT-II   9
Ordinary Differential Equations II: Series solution of second order differential equations with variable coefficient (Frobeneous method). Bessel and Legendre equations and their series solutions, Properties of Bessel function and Legendre polynomials.

UNIT-III   9
Partial Differential equations: Partial differential equations of the first order, Lagrange's solution, Charpit's general method of solution, Partial differential equations of the second order: Constant coefficient and reducible to constant coefficient, Classification of linear partial differential equations of second order.

UNIT-IV   9
Laplace Transform: Laplace Transform, Laplace transform of derivatives and integrals. Unit step function, Laplace transform of Periodic function. Inverse Laplace transform, Convolution theorem, Applications to solve simple linear and simultaneous differential equations and Partial Differential Equations.

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.
5. M.D. Raisinghania, Ordinary and Partial Differential Equations. S Chand Publications.

BSM-140/BSM-190	**Environmental Science and Green Chemistry**
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 home assignments, quizzes, minor tests, practical work, viva-voce, practical exam and major theory Examination
Course Objectives	Understanding the principles and concepts of Chemistry viz. Chemical Bonding, acidity and basicity, Atmospheric Chemistry & Water Chemistry, Spectroscopic analytical methods and Green Chemistry and solving industrial problems using solid foundation in Chemistry.
Course Outcomes:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. To develop the concepts of basic chemistry.
2. To make the students aware of global environmental issues e.g. global warming & Greenhouse effect, Ozone depletion, pollution and its prevention and understand various aspects of atmospheric chemistry.
3. To understand the analytical and conceptual skills required for environmental chemistry research.
4. To understand water treatment for all types of uses and need to protect environment.
5. To understand the specifications of pure water and its purification techniques.
6. To develop the knowledge about Green Chemistry and Green Technology.

Unit 1:   9
Basic Chemical Concepts: Periodic properties of elements, Ionization potential, electron affinity and electronegativity; mole concept, molarity and normality, Chemical Bonding – MO Theory, MO diagram of diatomic molecules, hydrogen bonding, electrophiles, nucleophiles, inductive effect and mesomeric effect. Reaction Mechanism. Acidity and basicity - Concept of pH.

Unit 2:   9

Atmospheric chemistry & Water Chemistry: The atmosphere of Earth, layers of atmosphere and temperature inversion, Air pollution, Global warming and Greenhouse effect. Acid rain and Ozone layer depletion. Chemical and photochemical Smog. Sources of water, conservation of water, impurities in water and their effects. WHO guideline and BIS guideline for drinking water. Hardness of water, Softening of water by Zeolite process, Lime Soda process, Ion exchange process and Reverse osmosis.

Unit 3:   **9**

Spectroscopic analytical methods: Absorbance, Transmittance and Beer-lamberts Law. Basic principles of UV-Visible spectroscopy, Fluorescence spectroscopy, Infrared spectroscopy, NMR Spectroscopy. Use of these instrumental techniques for monitoring of environmental pollution. Environmental problems posed by the use of non-biodegradable polymers widely used in day-to-day life. Incineration as the key method for disposal of polymeric waste. Bio-degradable polymers.

Unit 4:   **9**

Green Chemistry: Green Chemistry and Green Technology: New trends in Green chemistry; Green Chemistry Methodologies-Microwave heating, ultrasound technique. Green Chemical Synthesis Pathways; Green reagents, Green solvents.

Experiments:

1. Determination of temporary and permanent hardness in water sample using EDTA as standard solution.
2. Determination of alkalinity in the given water sample.
3. Determination of chloride content in the given water sample by Mohr's method.
4. Determination of percentage of available chlorine in bleaching powder sample.
5. Determination of iron content in the given sample using $K_3[Fe(CN)_6]$ as an external indicator.
6. Determination of Electrical conductivity/TDS of a given water sample using conductivity meter.
7. Determination of dissolved Carbon Dioxide of given water sample.
8. Determination of the biochemical oxygen demand of sewage influent.
9. To calculate the lambda max of the given compound by using UV-Visible spectrophotometer.
10. Determination of nickel / cobalt / copper solutions by UV–visible spectrometry.
11. Examples of Green Synthesis /Reactions.
12. Determination of Turbidity of Water
13. Iodoform test
14. Synthesis of a polymer Bakelite or Polyacrylic acid.

Books & References
1. A Text Book of Environment and Ecology, Shashi Chawla, Tata McGraw Hill
2. Environmental Studies, Raj Kumar Singh, Tata McGraw Hill
3. Engineering Chemistry, Wiley India
4. Engineering Chemistry, Tata McGraw Hill
5. Organic Chemistry, Morrison & Boyd, 6th edition, Pearson Education
6. Fundamentals of Environmental Chemistry, Manahan, Stanley E., Boca Raton: CRC Press LLC.
7. Environment and Ecology, R K Khandal, Wiley India
8. An Introductory Text on Green Chemistry: For Undergraduate Students, lndu Tucker Sidhwani, Rakesh K. Sharma, Wiley
9. A text book of Green Chemistry, Shankar Prasad Deo and Nayim Sepay, Techno World Publication.
10. Introduction to Green Chemistry, John Andraos, Albert S. Matlack, CRC Press

BEE-110/160   **Basic Electrical Engineering**

Course category	:	Engineering Fundamentals (EF)
Pre-requisite Subject	:	NIL
Contact hours/week	*:*	Lecture: 3, Tutorial: 0, Practical: 2
Number of Credits	:	4
Course Assessment methods	*:*	Continuous assessment through attendance, home assignments, quizzes, practical work, record, viva voce, 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.
		2. To demonstrate and understand the basic concepts of analysis of simple DC and AC circuits used in electrical engineering and apply the basic concepts in Electrical engineering for multi-disciplinary tasks.

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. Classify different electrical measuring equipment's and understanding their principles.
5. Understand the basic concepts of magnetic circuits.
6. Explain construction and working principle of transformer.

Topic Covered
UNIT I
D C Circuit Analysis and Network Theorems: **9**
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.

UNIT II   **9**
Introduction to AC Circuits:
AC fundamentals, Analysis of single phase 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   **9**
Measuring Instruments:
Fundamentals of measurement & instrumentation, Units, Dimensions and Standards. Error Analysis, types of errors & its analysis. Measuring instruments, construction and working principles of PMMC, Moving Iron and Electro-dynamometer type voltmeters & ammeters, Use of shunts and multipliers.

Magnetic Circuits and Transformers:
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.

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.

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

BHS- 102/152	**BHS- 102/152 TECHNICAL WRITING AND PROFESSIONAL COMMUNICATION(TW&PC)**
Course Category	: HSS
Prerequisite subject	: None
Number of Credits	: 4
Contact Hours/Week	: Lectures: 2, Tutorial: 1, Practical: 2
Course Assessment Methods	: Continuous assessment through One test, teacher's assessment (quiz, tutorial, assignment, attendance), and One Major Theory Examination.
Course Objectives	: The objectives of this course are to: - The course aims- 1. To sensitize the students to understand the role and importance of communication for personal and professional success. 2.To enable the learners to enhance their writing skills in techno-cultural and professional echo-system. 3.To equip learners to differentiate technical writing from general writing. 4.To equip them with technical writing skills. 5.To enable learners to exhibit knowledge, skills, attitude and judgment in and around human communication that facilitate their ability to work collaboratively with others in an interpersonal environment.
Course Outcomes	: The students will be able to demonstrate the following knowledge, skills, and attitudes upon completion of the course: -

1.Overcome the problems she/he shall faces in oral and written communication.
2.Acquire knowledge of and methods for using technical communication, such as reports, proposals, technical letters, etc.
3.Use and Practice compositions correctly.
4.Give presentations in different sessions and make self-appraisal.
5.Learn and understand the various facets of Communication Skills, such as (LSRW) Listening, Speaking, Reading, and writing, and identify, formulate, and solve real-life problems with a positive attitude; also inculcate, the habit of learning and developing communication and soft skills.

Unit 1:   6
Language and Communication
Language Vs communication: Communication as coding and decoding – signs, symbols & pictograph – verbal and non–verbal symbols – Language & communication; Types of Communication-functional, situational, verbal, and non-verbal, interpersonal, group, interactive, public, Mass Communication. Thinking and Articulation, critical, creative aspects of articulation.

Skills of Language Acquisition: Natural Language Acquisition Skills: Listening, Speaking, Reading & Writing {LSRW}; Language Acquisition Through Training: Listening, Speaking, Reading, Writing, Grammar & Vocabulary {LSRWGV}

Phrase, Clause & Sentence in Professional Drafting-Simplicity, Clarity and Conciseness of a Presentation, Differentiating between Professional and Creative Writing, Blending of Artistic/Professional Writing, Avoiding gender, racial, and other forms of bias in Professional Writing. Pre-writing, Drafting, and Re-writing.

Unit 2:   6
Towards Technical Writing:
Technical Paper Writing: Professional Paper Elements-Front Matter of a Paper, Main Text of a Paper, End Matter of a Paper: Organizing References and Bibliography, Order of a thesis and Paper Elements, Concluding Remarks. Methods of Research Paper Writing: Identification of Author and His Writing-Author's name and Affiliation, Joint Authorship of a Paper, Identification of Writing-Title, Keywords, Synopsis, Preface and Abstract. Drafting Research Article & Methodology.

Thesis/Dissertation Writing: Thesis Elements-Front Matter of a Thesis, Main Text of a Thesis, End Matter of a Thesis, Specimen—Thesis and Research Paper, Chapters and Sections-Introductory Chapters and Sections, Statement of the Problems, Plan and Scope, Core Chapters and Sections-Theoretical Analysis and Synthesis, Basic Assumption and Hypothesis.

Professional Presentation & Seminar Delivery Tools: Designing the Presentation; Establishing the Objectives. Making Professional PowerPoint Presentations, Signaling Structure of Presentation through Sentences and Crisp Phrases, Preparing Notes for Professional/Technical Presentation, Text Animation, White Board, Flip Charts, Diagrams, Preparing Cards. Seminar Presentations: Purpose modes and methods. Nascent Emerging Platforms for On-line Presentations viz. Zoom, Webex, Team & Meet etc.

Unit 3:   6
Professional Drafting: Letters vs. e-mails, Formal and Informal emails, Parts of e-mails, Types of e-mails, Managing tone of E-mails and business Letters, Examples of Letters and E-mail, Professional Correspondence through E-mail, Job Applications and cover Letters. Introduction to DOs (Demi-Official Letters)

Career & Correspondence: Developing a Professional C.V, Bio Data & Resume. Report Writing, Kinds of Reports, Length of Report, Parts of a Report, Terms of Reference, Collection of Facts,

Outlines of Report, Examples of Report, Technical Proposal, Elements of Proposal, Examples of Proposal, drafting of proposal.

Unit 4:   **6**

Conducting Professional Meeting: Pre-meeting Preparation, During Meeting: Action Taken Report (ATR) & New Agenda Points, Post Meeting Follow ups. Notice, Circular, Agenda & Meeting Minutes.

Introduction to Generation–Z, Cyber Identity & Professional Netiquettes for Netizens: Drafting E-mails, Blogs on social media, Videoconferencing. Managing Profiles on social media. What to Write and Share on social media. Telephone Etiquettes & Phubbing.

List of Practical:

1.   Introduction to Vowel and Consonant Sounds
2.   Monophthongs and Diphthongs
3.   Syllable, Word Stress & Intonation
4.   Harnessing Non-verbal Communication Skills in Cross-Cultural Environment for the establishment of an ideal Ecosystem to ensure Professional Success
5.   Developing Speech, and Proofreading the Same
6.   Argumentative Skills & Group Dynamics
7.   Preparing CV, Biodata & Resume
8.   Types of Interview and Interview Skills
9.   GD, PI & Telephonic Interview
10.   Presentation Skills, Extempore, Debate and Video Conferencing
11.   Netiquettes while Writing Blogs on social media.
12.   Ethical Usages of Generative AI

Text / Reference Books

1.   Acharya Anita. (2012) Interview Skills- Tips & Techniques. Yking Books, Jaipur.
2.   Basu, B. N., (2008) Technical Writing. PHI Learning Pvt. Ltd.., New Delhi.
3.   Chauhan, N. K & Singh, S. N. (2013) Formal Letters, Pankaj Publication International, New Delhi.
4.   Chhabra T.N. (2018) Business Communication. Sun India Publication New Delhi.
5.   Dubey Arjun et.al. (2016) Communication for Professionals. Alfa Publications, Delhi.
6.   Gibaldi, Joseph (2021). The MLA Handbook for Writers of Research Papers. Ed. IXth, Modern Language Association of America, NY, US.
7.   Gurumani, N. (2010) Scientific Thesis Writing and Paper Presentation, MJP Publishers, Chennai.
8.   Hamilton Richard. (2009) Managing Writers. Penguin, India.
9.   Mc Graw S. J. (2008) Basic Managerial Skills for All. Ed. 08th, Prentice Hall of India, New Delhi.
10.   Murphy & Hildebrandt. (2008) Effective Business Communication. Tata McGraw Hill New Delhi.
11.   Pandey, S.P., Singh, S. N. & Kumar, Raman, (2023) Exploring Digital Humanities: Challenges & Opportunities, MacBrain Publishing House, New Delhi.

BCE 161   **MECHANICS OF STRUCTURES**

Course category   **:** Professional Skill (PS)

Pre-requisite Subject   **:** NIL

Contact hours/week   **:** Lecture : 3, Tutorial : 0 , 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	:	The aim is to introduce engineering students to the basic principles of equilibrium and the behavior of structural elements and systems which include beams, struts, shafts and trusses under applied loads.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course 1. Able to compute the magnitude, direction of force, moment and conditions of equilibrium of rigid body and able to compute equivalent force. 2. Able to compute the centroids and center of gravity. 3. Know the moment of inertia of mass and area, and also how to compute it. 4. Understand the principle of virtual work and able apply them to find out forces and reactions. 5. Know the different mechanism of friction and computation of frictional forces. 6. Understand the Newton's second law and apply them on system of particles also develop ability to apply Newton's second law on rigid body.

Topics Covered

UNIT-I 9

Statics –Basics Concepts, Fundamental principles & concepts:

Introduction to Engineering Mechanics: Force Systems, Basic concepts, Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant Moment of Forces and its Applications; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems.

Friction:

Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack.

UNIT-II **9**

Moment of Inertia:

Centroid and Centre of Gravity, Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Mass moment inertia of circular plate, Cylinder, Cone, Sphere, Hook.

UNIT-III **9**

Analysis of structures- Trusses

Basic Structural Analysis, Equilibrium in three dimensions; Analysis of simple trusses by method of sections & method of joints, Zero force members, Simple beams and support reactions. Shear force and Bending Moment Diagram of Statically Determinate Beams.

Review of Particle Dynamics

Review of particle dynamics- rectilinear motion; Plane curvilinear motion (rectangular, path, and polar coordinates). Work-kinetic energy, power, potential energy. Impulse-momentum (linear, angular); Impact (Direct and oblique).

Plane kinematics of rigid bodies- Rotation

Introduction to Kinetics of Rigid Bodies, Basic terms, general principles in dynamics; Types of motion, Instantaneous center of rotation in plane motion and simple problems; D'Alembert's principle and its applications in plane motion and connected bodies; Work energy principle and its application in plane motion of connected bodies; Kinetics of rigid body rotation.

Virtual Work and Energy Method:

Virtual displacements, principle of virtual work for particle and ideal system of rigid bodies, Applications of energy method for equilibrium, Stability of equilibrium.

EXPERIMENTS

Any 10 experiments are to be conducted from the following:

1. To verify the law of parallelogram of forces
2. To study the equilibrium of a body under three forces.
3. To determine the coefficient of friction of a flat surface.
4. Friction experiment on screw-jack.
5. Experiment based on analysis of truss.
6. To determine the mass moment of inertia of rotating disc.
7. To conduct the tensile test and determine the ultimate tensile strength, percentage elongation for mild steel specimen.
8. To conduct the Impact (Izod/Charpy) on Impact-testing machine to find the impact Strength of specimen.
9. To determine the hardness of the given specimen using Vicker/Brinell/Rockwell hardness testing machine.
10. Simple & compound gear-train experiment.
11. Worm &Worm-wheel experiment for load lifting.
12. Belt-Pulley experiment

Textbooks

   1. Vector Mechanics for Engineers: Statics and Dynamics – Johnston. R.E., Beer. F., Eisenberg. E. R,& Mazurek. D., McGraw Hill
   2. Engineering Mechanics: Statics and Dynamics- Hibbler. R.C., Prentice Hall

Reference books

   1. Irving H. Shames (2006), Engineering Mechanics, 4th Edition, Prentice Hall
   2. F. P. Beer and E. R. Johnston (2011), Vector Mechanics for Engineers, Vol I - Statics, Vol II, – Dynamics, 9th Ed, Tata McGraw Hill
   3. R. C. Hibbler (2006), Engineering Mechanics: Principles of Statics and Dynamics, Pearson Press.
   4. Shanes and Rao (2006), Engineering Mechanics, Pearson Education,
   5. Hibler and Gupta (2010), Engineering Mechanics (Statics, Dynamics) by Pearson Education.

BCE 162		**Design Thinking in Civil Engineering**
Course category	:	VAC/AC
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture : 0, Tutorial : 0 , Practical: 2
Number of Credits	:	0
Course Assessment methods	:	Continuous assessment through attendance, home assignments, quizzes, practical work, record, viva voce and One Major Practical Examination

Course Objectives	:	The objective of this Course is to provide the new ways of creative thinking and Learn the innovation cycle of Design Thinking process for developing innovative products which are useful for a student in preparing for an engineering career.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course.

1. Compare and classify the various learning styles and memory techniques and Apply them in their engineering education.
2. Analyze emotional experience and Inspect emotional expressions to better understand users while designing innovative products
3. Develop new ways of creative thinking and Learn the innovation cycle of Design Thinking process for developing innovative products
4. Identification of real-time civil engineering problems and their innovative solutions.
5. Perceive individual differences and its impact on everyday civil engineering project decisions and further create a better project execution.

Topics Covered

UNIT-I

An Insight to Learning: Understanding the Learning Process, Kolb's Learning Styles, Assessing and Interpreting
Remembering Memory: Understanding the Memory process, Problems in retention, Memory enhancement techniques
Emotions: Experience & Expression: Understanding Emotions: Experience & Expression, Assessing Empathy, Application with Peers

UNIT-II

Basics of Design Thinking: Definition of Design Thinking, Need for Design Thinking, Objective of Design Thinking, Concepts & Brainstorming, Stages of Design Thinking Process (explain with examples) - Empathize, Define, Ideate, Prototype, Test
Being Ingenious & Fixing Problem: Understanding Creative thinking process, Understanding Problem Solving, Testing Creative Problem Solving

UNIT-III

Infrastructure Design Concepts: Introduction to infrastructure design approaches for different projects, Various IRC and IS codes guidelines for design of various infrastructure components. General Principles of Design, Drawing, Importance of Safety, Case study of best infrastructures projects in current scenario, Introduction to ethical construction practices, application of project management tools, Standards and Quality practices in production, construction, maintenance, and services.

UNIT-IV

Prototyping & Testing: Concept of Prototype, Prototyping – Virtual and Physical. Rapid Prototype Development process, Testing Methodology, Testing and Sampling process in civil engineering.
Energy and Environment: Conservation, environmental pollution, and degradation, Climate change, Environmental impact assessment.
Information and Communication Technologies (ICT) based tools and their applications in Engineering include networking, e-governance, and technology-based education, Ethics and values in the Engineering profession.

Textbooks

1. E Balaguruswamy (2022), Developing Thinking Skills (The way to Success), Khanna Book Publishing Company.

2. Change by Design, Tim Brown, Harper Bollins (2009)

3. Design Thinking in the Classroom by David Lee, Ulysses Press

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