B. TECH. FOUR YEARS

COURSE STRUCTURE AND SYLLABUS
FOR
MECHANICAL ENGINEERING
(AR23)

(Applicable for the batches admitted from 2023-24)

DEPARTMENT OF MECHANICAL ENGINEERING

ADITYA INSTITUTE OF TECHNOLOGY AND MANAGEMENT
(AN AUTONOMOUS INSTITUTION AFFILIATED TO JNTUGV, VIZIANAGARAM)

Approved By AICTE, New Delhi, Accredited By NBA, AICTE & NAAC, UGC, New Delhi, Listed Under 2(F) & 12(B), UGC, New Delhi, TEQIP Participated College.
K.KOTTURU, TEKKALI,- 532 201, SRIKAKULAM DIST., AP

VISION OF THE INSTITUTE

To evolve into a premier engineering institute in the country by continuously enhancing the range of our competencies, expanding the gamut of our activities and extending the frontiers of our operations.

MISSION OF THE INSTITUTE

Synergizing knowledge, technology and human resource, we impart the best quality education in Technology and Management. In the process, we make education more objective so that the efficiency for employability increases on a continued basis.

DEPARTMENT OF MECHANICAL ENGINEERING

Aditya Institute of Technology and Management established the Department of Mechanical Engineering (ME) in 2004 with an initial intake of 60 students and got approval for additional intake of another 60 seats in 2011-12. A Post Graduate Program (M. Tech) in Thermal Engineering was introduced in 2011-12 with an intake of 18 seats. The Department of ME feels proud to announce that this Institution has got accredited by NAAC. The college has got TEQIP funds in phase-II under sub-component 1.1. These two important additions surely enhance the prestige of the institution and in turn help students to improve their academic standards. Both the B. Tech and M. Tech programs were duly approved by the AICTE and Govt. of A.P. and permanently affiliated to JNTUGV, Vizianagaram. The Department has its UG Mechanical Engineering Program accredited thrice by NBA in 2013, 2017 and 2021. Further the UG B.Tech. intake has been enhanced to 180 in the year 2019. The Department has JNTUGV authorized research center with five research scholars pursuing their Ph.D. The Department is further equipped with skill oriented labs including Siemens-PLM authorized training centre and Applied Robot Control lab in association with European Centre for Mechatronics & Manufacturing, Germany. The State of art laboratories such as 3DX lab from Dassault Systemes, Automobile and Refrigeration-Air conditioning labs in association with AP State Skilled Development Center stand as assets to Department of Mechanical Engineering by which the skill-sets of students are being enhanced.

VISION OF THE DEPARTMENT

To emerge as one of the most preferred departments in the Southern region to produce professionally competent mechanical engineers.

MISSION OF THE DEPARTMENT

1. Provide students with a set of necessary knowledge, skills and attitude.
2. Develop the professional potential of students through comprehensive teaching and learning processes.
3. Inculcate life-long learning among the students to serve the profession and meet intellectual, ethical and career challenges.
4. Establish vital, state-of-the-art research facilities to provide its students and faculty with opportunities to create, interpret, apply and disseminate knowledge.

PROGRAM EDUCATIONAL OBJECTIVES

PEO 1: Attain successful careers in Mechanical or allied Engineering disciplines.

PEO 2: Create new methods and processes to solve contemporary mechanical engineering problems.

PEO 3: Exhibit ethical and leadership qualities in their chosen professional careers.

PROGRAM OUTCOMES

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Lifelong learning:** Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSO)

PSO 1 : Analyze and design mechanical components as per given specifications using Engineering and Design Analysis software tools.

PSO 2 : Evaluate thermal systems including IC engines, Refrigeration & Air - Conditioning, and Power generating systems.

PSO 3 : Apply traditional and modern to manufacture and assemble mechanical components with quality assurance.

ADITYA INSTITUTE OF TECHNOLOGY AND MANAGEMENT, TEKKALI

AR23 – COURSE STRUCTURE (1stB.Tech.)

(Proposed for Mechanical)

Year/Sem.	Category	Code	Theory/Lab	L	T	P	C
I B. Tech. (1st Sem)	MC	23MCS101	Induction Program	3 weeks			0
	BH	23BHT102	Linear Algebra and Calculus	2	1	0	3
	BH	23BHT104	Engineering Physics	3	0	0	3
	ES	23EST102	Basic Electrical and Electronics Engineering	3	0	0	3
	ES	23EST105	Introduction to Programming	3	0	0	3
	ES	23EST103	Engineering Graphics	1	0	4	3
	BH	23BHL102	Engineering Physics Lab	0	0	3	1.5
	ES	23ESL102	Basic Electrical and Electronics Engineering Lab	0	0	3	1.5
	ES	23ESL105	Computer Programming Lab	0	0	3	1.5
	MC	23MCS102	NSS/NCC/Scouts & Guides/Community Service	0	0	1	0.5
Total				**12**	**1**	**14**	**20**

Year/Sem.	Category	Code	Theory/Lab	L	T	P	C
I B. Tech. (2nd Sem)	BH	23BHT101	Communicative English	3	0	0	3
	BH	23BHT103	Differential Equations and Vector Calculus	2	1	0	3
	BH	23BHT106	Engineering Chemistry	3	0	0	3
	ES	23EST104	Engineering Mechanics	3	0	0	3
	PC	23MET101	Thermodynamics	3	0	0	3
	ES	23ESL104	Engineering Workshop	0	0	3	1.5
	BH	23BHL101	Communicative English Lab	0	0	3	1.5
	BH	23BHL104	Engineering Chemistry Lab	0	0	3	1.5
	MC	23MCS103	Health and Wellness, Yoga and Sports	0	0	1	0.5
Total				**14**	**1**	**10**	**20**

AR23 – Course Structure (2nd B.Tech.)
(Proposed for Mechanical Engineering)

Year/Sem.	Category	Code	Theory/Lab	L	T	P	C
II B. Tech. (1st Sem)	BH	23BHT209	Numerical Methods	3	0	0	3
	ES	23EST206	Python Programming	3	0	0	3
	PC	23MET202	Materials Engineering	2	0	0	2
	PC	23MET203	Mechanics of Solids	3	0	0	3
	PC	23MET204	Fluid Mechanics and Hydraulic Machines	3	0	0	3
	ES	23ESL207	Python Programming Lab	0	0	3	1.5
	PC	23MEL201	Mechanics of Materials and Metallurgy Lab	0	0	3	1.5
	PC	23MEL202	Fluid Mechanics and Hydraulic Machinery lab	0	0	3	1.5
	SC	23MES204	Skill Enhancement course –I	1	0	1	1.5
	MC	23MCT204	Environmental Studies	2	0	0	0
Total				**17**	**0**	**10**	**20**

Year/Sem.	Category	Code	Theory/Lab	L	T	P	C
II B. Tech. (2nd Sem)	BH	23BHT207	Universal Human Values	2	0	0	2
	BH	23BHT213	Managerial Economics and Financial Analysis	3	0	0	3
	PC	23MET205	Manufacturing Technology- I	3	0	0	3
	PC	23MET206	Heat and Mass Transfer	3	0	0	3
	PC	23MET207	Design of Machine Members - I	3	0	0	3
	ES	23ESL208	Competitive Programming Lab – I	0	0	3	1.5
	PC	23MEL203	Heat Transfer Lab	0	0	3	1.5
	PC	23MEL204	Design and Production Technology Lab	0	0	3	1.5
	SC	23MES205	Skill Enhancement course –II	1	0	1	1.5
	BH	23BHT208	Design Thinking	1	0	2	2
Total				**16**	**0**	**12**	**22**
Mandatory Community Service Project Internship of 02 weeks duration during summer vacation.							

R23 - B. Tech. - ME **I Year B. Tech. I Semester**

INDUCTION PROGRAMME
(Common to All Branches of Engineering)

Subject Code: 23MCS101

S.No.	Course Name	Category	L-T-P-C
1	Physical Activities -- Sports, Yoga and Meditation, Plantation	MC	0-0-6-0
2	Career Counseling	MC	2-0-2-0
3	Orientation to all branches -- career options, tools,etc.	MC	3-0-0-0
4	Orientation on admitted Branch -- corresponding labs, tools and platforms	EC	2-0-3-0
5	Proficiency Modules & Productivity Tools	ES	2-1-2-0
6	Assessment on basic aptitude and mathematicalskills	MC	2-0-3-0
7	Remedial Training in Foundation Courses	MC	2-1-2-0
8	Human Values & Professional Ethics	MC	3-0-0-0
9	Communication Skills -- focus on Listening, Speaking, Reading, Writing skills	BS	2-1-2-0
10	Concepts of Programming	ES	2-0-2-0

R23 - B. Tech. - ME **I Year B. Tech. I Semester**

LINEAR ALGEBRA & CALCULUS
(Common to All Branches of Engineering)

Subject Code: 23BHT102

L	T	P	C
2	1	0	3

COURSE OBJECTIVES:

To equip the students with standard concepts and tools of mathematics to handle various real-world problems and their applications as follows.

- Develop proficiency in fundamental algebraic techniques. Apply algebraic concepts to solve engineering problems and practical applications.
- Understand the principles of linear transformations. Explore the concept of orthogonal transformations. Apply these transformations in engineering contexts and problem-solving.
- Gain a deep understanding of calculus concepts. Apply calculus to analyze and solve real-world problems. Explore the applications of calculus in engineering and related fields.
- Understand the concept of functions with multiple variables. Explore optimization techniques using functions of several variables. Apply these concepts in engineering optimization problems
- Learn the concepts of double integrals in two dimensions. Understand triple integrals in three dimensions. Apply integration techniques for calculating areas and volumes in engineering applications.

COURSE OUTCOMES:

At the end of the course, the student will be able to

CO 1: Develop matrix algebra techniques that is needed by engineers for practical applications.
CO 2: To find the eigen values and eigen vectors and solve the problems by using linear transformation
CO 3: Learn important tools of calculus in higher dimensions.
CO 4: Familiarize with functions of several variables which is useful in optimization.
CO 5: Familiarize with double and triple integrals of functions of several variables in two and three dimensions.

UNIT - I: Matrices:

Rank of a matrix by echelon form, normal form. Inverse of Non- singular matrices by Gauss-Jordan method. System of linear equations: Solving system of Homogeneous and Non-Homogeneous equations by Gauss elimination method, Gauss Seidel Iteration Method.

UNIT- II: Linear Transformation and Orthogonal Transformation:

Eigen values, Eigen vectors and their properties(without Proof), Diagonalization of a matrix, Cayley-Hamilton Theorem (without proof), finding inverse and power of a matrix by Cayley-Hamilton Theorem, Quadratic forms and Nature of the Quadratic Forms, Reduction of Quadraticform to canonical forms by Orthogonal Transformation.

UNIT- III : Calculus :

Mean Value Theorems: Rolle's Theorem, Lagrange's mean value theorem with their geometrical interpretation, Cauchy's mean value theorem, Taylor's and Maclaurin theorems with remainders (without proof), Problems and applications on the above theorems.

UNIT- IV : Partial differentiation and Applications (Multi variable calculus) :

Partial derivatives, total derivatives, chain rule, change of variables, Taylor's and Maclaurin's series expansion of functions of two variables. Jacobians, maxima and minima of functions of two variables, method of Lagrange multipliers.

UNIT – V : Multiple Integrals (Multi variable Calculus):

Duble integrals - change of variables (Cartesian and Polar coordinates), Change of order of integration, cylindrical and spherical coordinates. Finding areas (by double integrals) and volumes (by double integrals and triple integrals).

Text books:

1. B.S.Grewal,HigherEngineeringMathematics,44/e, Khanna Publishers,2017.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2018.

Reference Books:

1.R.K.Jain and S.R.K.Iyengar, Advanced Engineering Mathematics, 5/e, Alpha ScienceInternational Ltd.,2021 (9th reprint).

2.George B. Thomas, Maurice D.Weir and Joel Hass, Thomas Calculus,14/e, PearsonPublishers, 2018.

3.Glyn James, Advanced Modern Engineering Mathematics, 5/e, Pearson publishers, 2018.

4.Michael Greenberg, Advanced Engineering Mathematics, 9thedition, Pearson edn

5.H. K Das, Er. Rajnish Verma, Higher Engineering Mathematics, S. Chand,2021.

R23 - B. Tech. - ME **I Year B. Tech. I Semester**

ENGINEERING PHYSICS
(Common to All Branches of Engineering)

Subject Code: 23BHT104

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- Bridging the gap between the Physics in school at 10+2 level and UG level engineering courses.
- To identify the importance of the optical phenomenon. interference, diffraction and polarization related to its Engineering applications
- Enlighten the periodic arrangement of atoms in Crystalline solids by Bragg's law
- To explain the significant concepts of dielectric and magnetic materials that leads to potential applications in the emerging micro devices.
- Enlightenment of the concepts of Quantum Mechanics and to provide fundamentals of deBroglie matter waves, quantum mechanical wave equation and its application, the importance of free electron theory for metals.
- To Understand the Physics of Semiconductors and their working mechanism, Concept utilization of transport phenomenon of charge carriers in semiconductors.

COURSE OUTCOMES

CO 1: Explain the need of coherent sources and the conditions for sustained interference (L2). **Identify** the applications of interference in engineering (L3). **Analyze** the differences between interference and diffraction with applications (L4). **Illustrate** the concept of polarization of light and its applications (L2).

CO 2:Classify various crystal systems (L2). **Identify** different planes in the crystal structure (L3).**Analyze** the crystalline structure by Bragg's X-ray diffracto meter (L4).

CO 3:Explain the concept of dielectric constant and polarization in dielectric materials (L2).**Summarize** various types of polarization of dielectrics (L2). Interpret Lorentz field and Claussius-Mosotti relation in dielectrics (L2). **Classify** the magnetic materials based on susceptibility and their temperature dependence (L2).

CO 4: Describe the dual nature of matter (L1). **Explain** the significance of wave function (L2). **Identify** the role of Schrodinger's time independent wave equation in studying particle in one-dimensional infinite potential well (L3). **Identify** the role of classical and quantum free electron theory in the study of electrical conductivity (L3).

CO5:Classify the crystalline solids (L2).**Outline** the properties of charge carriers in semiconductors (L2).**Identify** the type of semiconductor using Hall effect (L2). **Apply** the concept of effective mass of electron (L3).

UNIT-I: Wave Optics

Interference: Introduction - Principle of superposition –Interference of light - Interference in thin films (Reflection Geometry) & applications - Colors in thin films- Newton's Rings-Determination of wavelength and refractive index.

Diffraction: Introduction - Fresnel and Fraunhofer diffractions - Fraunhofer diffraction due to single slit, double slit & Diffraction Grating (Qualitative).

Polarization: Introduction -Types of polarization - Polarization by reflection, and Double refraction - Nicol's Prism -Half wave and Quarter wave plates.

UNIT II: Crystallography

Crystallography: Space lattice, Basis, Unit Cell and lattice parameters – Bravais Lattices – crystal systems (3D) – coordination number - packing fraction of SC, BCC & FCC - Miller indices – separation between successive (hkl) planes. Bragg's law - X-ray Diffractometer – crystal structure determination by Laue method and Powder method.

UNIT-III: Dielectric And Magnetic Materials

Dielectric Materials: Introduction - Dielectric polarization - Dielectric polarizability, Susceptibility, Dielectric constant and Displacement Vector - Types of polarizations- Electronic (Quantitative), Ionic (Quantitative) and Orientation polarizations (Qualitative) - Lorentz internal field - Clausius-Mossotti equation.

Magnetic Materials: Introduction - Magnetic dipole moment - Magnetization-Magnetic susceptibility and permeability - Classification of magnetic materials: Dia, Para, Ferro, Anti ferro & Ferri magnetic materials - Domain concept for Ferromagnetism (Qualitative) - Hysteresis - soft and hard magnetic materials.

UNIT-IV: Quantum Mechanics and Free electron theory

Quantum Mechanics: Dual nature of matter – Heisenberg's Uncertainty Principle – Significance and properties of wave function – Schrodinger's time independent and dependent wave equations– Particle in a one-dimensional infinite potential well.

Free Electron Theory: Classical free electron theory (Qualitative with discussion of merits and demerits) – Quantum free electron theory – electrical conductivity based on quantum free electron theory - Fermi-Dirac distribution and its temperature dependence.

UNIT – V: Semiconductors

Semiconductors: Formation of energy bands – classification of crystalline solids - Intrinsic semiconductors: Density of charge carriers – Electrical conductivity – Extrinsic semiconductors: density of charge carriers - Drift and diffusion currents – Einstein's equation - Hall effect and its Applications.

Text Books

1. "A Text book of Engineering Physics" - M. N. Avadhanulu, P.G.Kshirsagar& TVS ArunMurthy,S.Chand Publications, 11th Edition 2019.
2. "EngineeringPhysics"-D.K.Bhattacharyaand PoonamTandon,Oxford press(2015).
3. "EngineeringPhysics"-P.K.Palanisamy SciTechpublications.

Reference Books

1. “Fundamentals of Physics” - Halliday, Resnick and Walker, John Wiley &Sons.
2. “Engineering Physics” - M.R. Srinivasan, New Age international publishers (2009).
3. “Engineering Physics” - Shatendra Sharma, Jyotsna Sharma, Pearson Education, 2018.
4. “Engineering Physics” - Sanjay D. Jain, D. Sahasrabudhe and Girish, University Press.
5. “Semiconductor physics and devices:Basic principle” - A. Donald, Neamen, Mc GrawHill.
6. “Engineering Physics” - B.K. Pandey and S. Chaturvedi, Cengage Learning
7. “Solid state physics” – A.J.Dekker ,Pan Macmillan publishers
8. “Introduction to Solid State Physics” -Charles Kittel ,Wiley

R23 - B. Tech. - ME **I Year B. Tech. I Semester**

BASIC ELECTRICAL & ELECTRONICS ENGINEERING
(Common for CSE-IT-CSM-CSD-MECH-CE)

L	T	P	C
3	0	0	3

Subject Code: 23EST102

COURSE OBJECTIVES:

- To introduce the basic knowledge of electric circuits
- To analyze AC circuits.
- To provide knowledge on Magnetic circuits.
- To understand the working, characteristics of PN Junction diode, Zener diode
- To explain the working, characteristics of transistor (BJT) in different configurations, JFET and MOSFET.

COURSE OUTCOMES:

CO 1: Able to summarize different electrical circuits.
CO 2: Able to outline the basics of AC circuits.
CO 3: Able to examine DC Generator & DC Motor.
CO 4: Able Describe the working principle of PN Junction diode, Zener diode
CO 5: Able to Describe the working and behavior of transistor (BJT) in different configurations, JFET and MOSFET.

UNIT –I: Introduction to Electric Circuits

Basic definitions, Electrical circuit elements (R, L and C), Voltage and current sources Independent and dependent sources, Ohm's Law, Series & Parallel circuits, Source transformation, Kirchhoff's Laws, Faraday's laws of electromagnetic induction, Lenz's law, simple problems.

UNIT-II: AC Circuits: Representation of sinusoidal waveforms, peak and rms values, phasor representation, Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series only), real power, reactive power, apparent power, power factor, simple problems.

UNIT-III: DC Machines

DC Generator: Generator-Principle of Operation, Construction, EMF equation, Classification, O.C.C, internal and external characteristics of shunt generator, Applications.

DC Motor: Motor-principle of operation, Torque equation, Classification Speed Control Methods, Operation of 3 point starter, Applications.

UNIT-IV: Diode Characteristics

Formation of PN junction diode, V-I Characteristics of Diode, Diode as a switch, Zener Diode Characteristics, Zener Diode as Voltage Regulator.

UNIT-V: Transistor Characteristics

Bipolar Junction Transistors (BJT) - input & output Characteristics of transistor in CB, CE, CC configurations, Relationship between α, β and γ. Field effect transistors (FET) -Characteristics of JFET, MOSFET (Enhancement and depletion)

TEXT BOOKS

1. Principles of Electrical and Electronics Engineering by V.K.Mehta, S.Chand& Co.
2. Integrated Electronics – Jacob Millman, Chritos C. Halkies, Tata Mc-Graw Hill,2009.

REFERENCE BOOKS

1. Basic Electrical Engineering Dr.K.B.Madhu Sahu scitech publications (india) pvt.ltd.
2. Electronic Devices and Circuits – R.L. Boylestad and Louis Nashel sky, Pearson/Prentice Hall, 9thEdition, 2006.
3. D. P. Kothari and I. J. Nagrath, “Basic Electrical Engineering”, Tata McGraw Hill,2010.

R23 - B. Tech. - ME **I Year B. Tech. I Semester**

INTRODUCTION TO PROGRAMMING
(Common to All Branches of Engineering)

Subject Code: 23EST105

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

To impart adequate knowledge on the need of programming languages and problem-solving techniques and develop programming skills.

COURSE OUTCOMES

On completion of this course, the student will be able to:

CO 1: Understand the fundamentals of Computers and C programming

CO 2: Develop programs using control structures and Arrays to store and manipulate data

CO 3: Design modular programs using functions and storage classes

CO 4: Use structures and pointers to manipulate record based data

CO 5: Implement and manipulate files on secondary storage media

UNIT – I

Introduction to Programming: Introduction to components of Computer system, Algorithm, Flow chart, Program development steps, C Tokens, Data Types, Operator precedence and associativitiy, Structure of C program, simple programs using Basic I/O statements.

UNIT – II

Control Structures: Decision statements: if, if-else, nested if, if-else-if ladder, and switch

Iterative statements: while loop, do-while loop, for loop, nested loops

Branching: Break, continue

Arrays: Definition, Types: Single Dimensional arrays, Multi Dimensional arrays, declaration, initialization, accessing elements, Matrix operations and String Handling.

UNIT – III

Functions: Definition, Declaration, Types of Functions, Parameter passing, Call by value and call by reference, Passing Arrays to functions, Recursion, Scope and lifetime of variables, Command line arguments, Storage classes.

Pointers: Definition, Declaration, Initialization, Pointer arithmetic, functions and pointers, Pointer to pointer, Uses of Pointers, arrays and pointers.

UNIT – IV

Structures: Definition, Declaration, Accessing the structure elements, Array of structures, Arrays with in structures, pointer to structure, Self referential structure, passing structure to function, nested structures and unions, Dynamic memory allocation.

UNIT – V

File Handling: Introduction, Types of files, Defining and Opening a File, Closing a File, Input/Output operations on Files, Error Handling during I/O operations, Random Access to Files.

Text Books

1. B. W Kernighan, Dennis M. Ritchie. The C – Programming Language. 2nd Edition, PHI.
2. Behrouz A. Forouzan, "A Structured Approach Using C" Richard F. Gilberg 3rd Edition

References

1. Yashwant Kantikar. 2012. Let Us C, 8th Ed. PBP Publications.
2. E. Balagurusamy. 2011. C Programming. Tata Mc Graw Hills, New Delhi, India.

Web Links:

1. https://www.tutorialspoint.com › C programming › C – Home
2. https://www.programiz.com/c-programming

R23 - B. Tech. - ME **I Year B. Tech. I Semester**

ENGINEERING GRAPHICS
(Common for ME/CE)

Subject Code: 23EST103

L	T	P	C
1	0	4	3

COURSE OBJECTIVES:

- To enable the students with various concepts like dimensioning, conventions and standards related to Engineering Drawing
- To impart knowledge on the projection of points, lines, planes, and solids
- To develop the imaginative skills of the students required to understand the development of surfaces
- To improve the visualization skills for better understanding of conversion of orthographic to isometric views and vice-versa

COURSE OUTCOMES:

On completion of course, students should be able to

CO 1 : Understand the principles of engineering drawing, including engineering curves, conics, cycloid and Involutes.

CO 2 : Draw projection of points, straight lines and planes in first angle projection.

CO 3 : Understand and draw projection of solids in various positions in first quadrant.

CO 4 : Draw and explain the principles behind development of surfaces.

CO 5 : Convert orthographic views into isometric projections and vice-versa.

UNIT I

Drawing Instruments and their uses, Types of Lines and Dimensioning, Line bisecting, Angle bisecting, Line divided into equal number of parts, Construction of Regular Polygons (Pentagon and Hexagon).

Construction of Conics: General method**,** Oblong method and Concentric circles method.

Construction of Cycloid and Involutes.

UNIT II

Introduction to Orthographic Projections (First Angle Projection only).

Projections of Points: A point situated in I,II,III & IV quadrants.

Projections of Straight Lines: Line parallel to one or both the planes, Line contained by one or both the planes, Line perpendicular to one of the planes, Line inclined to one plane and parallel to other.

Projections of Planes: Types of planes, Traces of planes, planes parallel to one of the planes, and plane inclined to one reference plane.

UNIT III

Projections of Solids (Polyhedra): Types of Solids, Projections of Solids in simple positions, Projections of Solids axis inclined to the VP and parallel to the HP. Projections of Solids axis inclined to the HP and parallel to the VP.

Projections of Solids (Solids of revolution): Projections of Solids axis inclined to the VP and parallel to the HP. Projections of Solids axis inclined to the HP and parallel to the VP.

UNIT IV

Development of Surfaces:

Parallel line method of development, Developments of lateral surfaces of right Solids i.e., Cube, Prisms, Cylinders.

Radial line method of development, Triangulation method. Development of lateral surfaces of right Solids i.e., Pyramids, Cones.

UNIT V

Orthographic Projections: Conversion of pictorial view (Isometric views) into orthographic views.

Isometric Projections: Isometric axes, lines & planes. Isometric scale, Isometric drawing, Isometric drawing of plane figures, prisms and pyramids. Conversion of orthographic views into Isometric views.

TEXT BOOKS:

1. Engineering Drawing, N. D. Bhatt, V. M. Panchal, Charotar Pub.
2. Engineering Drawing, K. L .Narayana, P.Kanniah, Scitech Pub.

REFERENCE BOOKS:

1. Engineering Drawing and Graphics, 2nd ed., K. Venugopal, New Age International Pub.
2. Fundamentals of Engineering Drawing, 11th ed., Luzadder, J. Warren, D.M. Jon, Prentice Hall India Pub.

R23 - B. Tech. - ME **I Year B. Tech. I Semester**

ENGINEERING PHYSICS LAB
(Common to All Branches of Engineering)

Subject Code: 23BHL102

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

To study the concepts of optical phenomenon like interference, diffraction etc., recognize the importance of energy gap in the study of conductivity and Hall effect in semiconductors and study the parameters and applications of dielectric and magnetic materials by conducting experiments.

COURSE OUTCOMES: The students will be able to

CO1: Operate optical instruments like travelling microscope and spectrometer.
CO2: Estimate the wave lengths of different colors using diffraction grating.
CO3: Discuss the magnetic, electrical and electronic properties of materials.
CO4: Analyze the mechanical and thermal properties of materials.
CO5: Calculate the band gap of a given semiconductor.

List of Experiments

1. Determination of radius of curvature of a given Plano-convex lens by Newton's rings.
2. Determination of wavelengths of different spectral lines in mercury spectrum using diffraction grating in normal incidence configuration.
3. Determination of width of a slit using diffraction phenomenon.
4. Determination of wavelength of Laser light using diffraction grating.
5. Estimation of Planck's constant using photo cell.
6. To study V-I characteristics of a PN junction diode in forward and reverse biasing conditions.
7. Magnetic field along the axis of a current carrying circular coil by Stewart Gee's Method.
8. Determination of Hall voltage and Hall coefficient of a given semi-conductor using Hall effect.
9. Determination of temperature coefficients of a thermistor.
10. Determination of acceleration due to gravity and radius of Gyration by using a compound pendulum.
11. Determination of rigidity modulus of the material of the given wire using Torsional pendulum.
12. Sonometer: Verification of laws of stretched string.
13. Determination of Frequency of electrically maintained tuning fork by Melde's experiment.
14. Determination of energy band gap of a given semiconductor
15. Determination of thickness of a thin object using wedge shaped film.
16. Determination of crystal structure and lattice parameter of a given crystal using powder diffraction data.
17. Determination of Young's modulus of the given beam by non-uniform bending.
18. Determination of dielectric constant using resonance method.

Note: Any TEN of the listed experiments are to be conducted. Out of which any TWO experiments may be conducted in virtual mode.

References:

- A Textbook of Practical Physics - S. Balasubramanian, .N. Srinivasan, S.Chand Publishers, 2017.

Web Resources

- www.vlab.co.in
- https://phet.colorado.edu/en/simulations/filter?subjects=physics&type=html,prototype

R23 - B. Tech. - ME **I Year B. Tech. I Semester**

BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LAB

(Common for CSE-IT-CSM-CSD-MECH-CE)

Subject Code: 23ESL102

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVE:

To introduce the student to study different electrical & electronics components and to verify the basic laws related to electrical engineering, analyze the V-I characteristics of P-N diode and transistor characteristics.

COURSE OUTCOMES: Students will be able to

CO1: Label various types of electrical & electronics components.
CO2: Demonstrate various basic electrical laws.
CO3: Determine resistance of the series and parallel connected circuits.
CO4: Analyze the V-I characteristics of P-N diode.
CO5: Analyze the Transistor characteristics.

List of Experiments:

1. Study of electrical components.
2. To verify Ohm's law.
3. To verify Kirchhoff's current law
4. To verify Kirchhoff's voltage law.
5. To verify the total resistance of the series and parallel connected circuits.
6. Study of electronics components.
7. PN Junction diode forward and reverse bias characteristics
8. Zener diode characteristics.
9. Transistor CB characteristics (Input and Output)
10. Transistor CE characteristics (Input and Output)

Additional Experiments:

11. Half wave rectifier
12. To find voltage current relationship for series RL circuit and determine power & power factor.

R23 - B. Tech. - ME **I Year B. Tech. I Semester**

COMPUTER PROGRAMMING LAB

(Common to All Branches of Engineering)

Subject Code: 23ESL105

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

- To gain experience about structured programming
- To help students to understand the implementation of C language
- To understand various features in C

COURSE OUTCOMES: At the end of the course students will be able to

CO 1: Solve the given problem using the syntactical structures of C language.
CO 2: Design programs involving decision structures and loops.
CO 3: Apply programming to solve different operations on arrays and strings.
CO 4: Develop modularity concept using functions and write programs for allocating memory dynamically.
CO 5: Construct C program that uses structures and unions and implement file operations on given application.

List of Experiments

1. Write the C programs to calculate the following

a) Area of triangle when sides are given.

b) Program for Type Casting.

c) Interchanging values of two variables.

2. Write the C programs to perform the following

a) Conversion of Fahrenheit to Celsius and vice versa

b) Simple interest calculation

c) Square root of a given number

3. Write the C programs to perform the following

a) Read lower case character and convert into upper case.

b) Find maximum of 3 values using conditional operator.

c) Calculate area and perimeter of circle.

4. Write C programs for the following using decision making statements

a) Find roots of quadratic equation.

b) Find the max and min of three numbers using if-else.

c) Calculate the grades of a student.

d) Find the given year is a leap year or not.

5. Write the C programs to perform the following

a) Arithmetical operations using switch-case.

b) Read a number and display in reverse.

c) Check for Armstrong number property

6. Write the C programs to perform the following

a) Find factorial of given number

b) Check a number is palindrome property

c) Generate Fibonacci series.

d) Generate Prime numbers between two numbers.

7. Implement the following using arrays

a) Largest and smallest from a list of elements.

b) Program for Linear Search.

c) Program for Bubble Sort.

8. Implement the following using arrays

a) Matrix addition.

b) Matrix Multiplication.

c) Transpose of a matrix.

d) Program using string handling functions.

9. Write the C programs to perform the following

a) Factorial using recursion and non recursion.

b) GCD using recursion and non recursion.

10. Write the C programs to perform the following

a) Find the sum and average of list of elements using DMA Functions

b) Implementation of call by value and call by reference.

11. Write the C programs to perform the following

a) Implementation of array of structure.

b) Demonstration of Union.

12. Write the C programs to perform the following

a) Write a C program to write and read text into a binary file using fread() and fwrite()

b) Copy the contents of one file into another.

c) Count the number of characters, words and lines in a file.

Text Books:

1. B. W Kernighan, Dennis M. Ritchie. The C – Programming Language. 2 nd Edition, PHI.
2. Behrouz A. Forouzan, “A Structured Approach Using C” Richard F. Gilberg 3rd Edition

References:

1. Yashwant Kantikar. 2012. Let Us C, 8th Ed. PBP Publications.
2. E. Balagurusamy. 2011. C Programming. Tata Mc Graw Hills, New Delhi, India.

Web Links:

1. https://www.tutorialspoint.com › C programming › C – Home
2. https://www.programiz.com/c-programming

R23 - B. Tech. - ME **I Year B. Tech. I Semester**

NSS/NCC/Scouts & Guides/Community Service
(Common to All Branches of Engineering)

Subject Code: 23MCS102

Course Objectives:
The objective of introducing this course is to impart discipline, character, fraternity, teamwork, social consciousness among the students and engaging them in selfless service.

Course Outcomes: After completion of the course the students will be able to
CO1: Understand the importance of discipline, character and service motto.
CO2: Solve some societal issues by applying acquired knowledge, facts, and techniques.
CO3: Explore human relationships by analyzing social problems.
CO4: Determine to extend their help for the fellow beings and downtrodden people.
CO5: Develop leadership skills and civic responsibilities.

UNIT I: Orientation
General Orientation on NSS/NCC/ Scouts & Guides/Community Service activities, career guidance.
Activities:
i) Conducting –ice breaking sessions-expectations from the course-knowing personal talents and skills
ii) Conducting orientations programs for the students –future plans-activities-releasing road map etc.
iii) Displaying success stories-motivational biopics- award winning movies on societal issues etc.
iv) Conducting talent show in singing patriotic songs-paintings- any other contribution.

UNIT II: Nature & Care Activities:
i) Best out of waste competition.
ii) Poster and signs making competition to spread environmental awareness.
iii) Recycling and environmental pollution article writing competition.
iv) Organising Zero-waste day.
v) Digital Environmental awareness activity via various social media platforms.
vi) Virtual demonstration of different eco-friendly approaches for sustainable living.
vii) Write a summary on any book related to environmental issues.

UNIT III: Community Service Activities:
i) Conducting One Day Special Camp in a village contacting village-area leaders- Survey in the village, identification of problems- helping them to solve via media- authorities- experts-etc.

ii) Conducting awareness programs on Health-related issues such as General Health, Mental health, Spiritual Health, HIV/AIDS,

iii) Conducting consumer Awareness. Explaining various legal provisions etc.

iv) Women Empowerment Programmes- Sexual Abuse, Adolescent Health and Population Education.

v) Any other programmes in collaboration with local charities, NGOs etc.

Reference Books:

1. Nirmalya Kumar Sinha & Surajit Majumder, *A Text Book of National Service Scheme* Vol;.I, Vidya Kutir Publication, 2021 (ISBN 978-81-952368-8-6)

2. *Red Book - National Cadet Corps* – Standing Instructions Vol I & II, Directorate General of NCC, Ministry of Defence, New Delhi

3. Davis M. L. and Cornwell D. A., ―Introduction to Environmental Engineering‖, McGraw Hill, New York 4/e 2008

4. Masters G. M., Joseph K. and Nagendran R. ―Introduction to Environmental Engineering and Science‖, Pearson Education, New Delhi. 2/e 2007

5. Ram Ahuja. *Social Problems in India*, Rawat Publications, New Delhi.

General Guidelines:

1. Institutes must assign slots in the Timetable for the activities.

2**.** Institutes are required to provide instructor to mentor the students.

Evaluation Guidelines:

- Evaluated for a total of 100 marks.
- A student can select 6 activities of his/her choice with a minimum of 01 activity per unit. Each activity shall be evaluated by the concerned teacher for 15 marks, totalling to 90 marks.
- A student shall be evaluated by the concerned teacher for 10 marks by conducting viva voce on the subject.

R23 - B. Tech. - ME **I Year B. Tech. II Semester**

COMMUNICATIVE ENGLISH
(Common to All Branches of Engineering)

Subject Code: 23BHT101

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To enable students to build vocabulary appropriate to their levels and to make students understand printed texts of different genres
- To enhance basic writing skills of the students in different forms of written communication
- To assist students implicitly synthesize the rules of grammar for the production of accurate sentences
- To aid students to acquire appropriate and adequate letter writing skills
- To get students enhance their essay writing skills and develop reading skills

COURSE OUTCOMES

CO 1: Students will be able to comprehend printed texts of different genres easily and they will be able to make appropriate word choice for writing.
CO 2: Students will be able to write short texts efficiently.
CO 3: Students will be able to construct grammatically correct sentences.
CO 4: Students will be able to communicate through letters effectively.
CO 5: Students will be able to write essays and comprehend unfamiliar passages.

UNIT–I: A Power of a Plate of Rice by Ifeoma Okoye Skimming and Scanning — Capital letters and Punctuation — Spellings — Parts of speech — Root words — Prefixes and Suffixes — Synonyms and Antonyms.
UNIT–II: *Night of the Scorpion* by Nissim Ezekiel Sequencing — Paragraph writing — Cohesive devices — Articles — Prepositions Homonyms, Homographs, homophones

UNIT–III: *Biography of Steve Jobs* Drawing inferences — Paraphrasing, Summarizing, Note-making — Verbs and Tenses, Subject-verb agreement — Compound words — Collocations

UNIT–IV: *The Toys of Peace* by Saki Data interpretation — Official letters and Résumé — Direct and Indirect speech — Academic reporting verbs — Active and passive voice — Words often confused — Jargon

UNIT–V: *The Power of Intrapersonal Communication* (An Essay) Reading comprehension — Essay writing — Correcting errors — Technical Jargon

Textbooks:

1. Pathfinder: Communicative English for Undergraduate Students, 1st Edition, Orient BlackSwan, 2023 (Units 1, 2 & 3)
2. Empowering English by Cengage Publications, 2023 (Units 4 & 5)

Reference Books:

1. Dubey, Sham Ji & Co. English for Engineers, Vikas Publishers, 2020
2. Bailey, Stephen. Academic writing: A Handbook for International Students. Routledge, 2014.
3. Murphy, Raymond. English Grammar in Use, Fourth Edition, Cambridge University Press, 2019.
4. Lewis, Norman. Word Power Made Easy- The Complete Handbook for Building a Superior Vocabulary. Anchor, 2014.

Web Resources:

GRAMMAR

1. www.bbc.co.uk/learningenglish
2. https://dictionary.cambridge.org/grammar/british-grammar/
3. www.eslpod.com/index.html
4. https://www.learngrammar.net/
5. https://english4today.com/english-grammar-online-with-quizzes/
6. https://www.talkenglish.com/grammar/grammar.aspx

VOCABULARY

1. https://www.youtube.com/c/DailyVideoVocabulary/videos
2. https://www.youtube.com/channel/UC4cmBAit8i_NJZE8qK8sfpA

R23 - B. Tech. - ME **I Year B. Tech. II Semester**

DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS
(Common to All Branches of Engineering)

Subject Code: 23BHT103

L	T	P	C
2	1	0	3

COURSE OBJECTIVES:

To equip the students with standard concepts and tools of mathematics to handle various real-world problems and their applications as follows

- To furnish the learners in the concept of first order and first degree differential equations and multivariable calculus.
- To enlighten the learners in the concept of higher order differential equations with constant coefficients.
- To furnish the learners with solution methods for partial differential equations that model physical processes
- To equip knowledge with basic concepts and techniques to interpret the physical meaning of different operators such as gradient, curl and divergence by handling various real-world applications
- To furnish the learners with basic concepts and techniques the work done against a field, circulation and flux using vector calculus by handling various real-world applications.

COURSE OUTCOMES: At the end of the course, the student will be able to:

CO 1: Solve the differential equations related to various engineering fields.
CO 2: Model engineering problems as higher order differential equations and solve analytically.
CO 3: Identify solution methods for partial differential equations that model physical processes.
CO 4: Interpret the physical meaning of different operators such as gradient, curl and divergence.
CO 5: Estimate the work done against a field, circulation and flux using vector calculus.

UNIT- I : Differential equations of first order and first degree

Exact equations and equations reducible to exact form. Linear differential equations – Bernoulli's equations. Newton's Law of cooling – Law of natural growth and decay- Electrical circuits

UNIT – II : Linear differential equations of higher order (Constant Coefficients)

Definitions, homogenous and non-homogenous, complimentary function, general particular integral, method of variation of parameters. L-C-R Circuit problems.

UNIT – III : Partial Differential Equations

Introduction and formation of Partial Differential Equations by elimination of arbitrary constants and arbitrary functions, solutions of first order linear equations using Lagrange's method. Homogeneous Linear Partial differential equations with constant coefficients.

UNIT - IV : Vector differentiation

Scalar and vector point functions, vector operator del, del applies to scalar point functions-Gradient,del applied to vector point functions - Divergence and Curl, Vector identities.

UNIT –V : Vector integration

Line integral- circulation- work done, surface integral-flux, Green's theorem in the plane (without proof), Stoke's theorem (without proof), volume integral, Divergence theorem (without proof) and problems on these theorems.

Textbooks:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10/e,John Wiley & Sons, 2018.
2. B.S.Grewal,HigherEngineeringMathematics,44/e,Khanna publishers,2017.

Reference Books:

1. Dennis G.Zill and Warren S.Wright, Advanced Engineering Mathematics, Jones andBartlett, 2018.
2. Micheael Greenberg, Advanced Engineering Mathematics, 9th edition, Pearson edn
3. George B. Thomas, Maurice D. Weir and Joel Hass, Thomas Calculus, 14/e, PearsonPublishers, 2018.
4. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, 5/e, Alpha Science International Ltd., 2021 (9th reprint).
5. B.V. Ramana, Higher Engineering Mathematics, McGraw Hill Education, 2017

R23 - B. Tech. - ME **I Year B. Tech. II Semester**

ENGINEERING CHEMISTRY
(Common for CE/ME)

Subject Code: 23BHT106

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To familiarize engineering chemistry and its applications
- To impart the concept of soft and hard waters, softening methods of hard water
- To train the students on the principles and applications of electrochemistry, polymers, surface chemistry, and cement

COURSE OUTCOMES: At the end of the course, the students will be able to

CO1: Demonstrate the importance of water for society and industrial needs.
CO2: Summarize the concepts of Instrumental methods and distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques.
CO3: Demonstrate the corrosion prevention methods and factors affecting corrosion.
CO4: Demonstrate the preparation, properties, and applications of polymer materials and fuels.
CO5: Demonstrate the importance of modern engineering materials like cement, refractories, composites, and lubricants.

UNIT I: Water Technology

Soft and hard water, Estimation of hardness of water by EDTA Method, Estimation of dissolved Oxygen - Boiler troubles –Priming, foaming, scale and sludge, Caustic embrittlement, Industrial water treatment – Specifications for drinking water, Bureau of Indian Standards (BIS) and World health organization (WHO) standards, Ion-exchange processes - desalination of brackish water, reverse osmosis (RO) and electro dialysis.

UNIT II: Instrumental Methods and Applications

Electromagnetic spectrum. Absorption of radiation: Beer-Lambert's law. UV-Visible Spectroscopy, Instrumentation, electronic transition, Definition of Chromophore – Definition of Auxochrome – Absorption and Intensity Shifts, IR spectroscopies, Instrumentation fundamental modes and Fingerprint Region. NMR – Principle - Equivalent and Non-Equivalent Protons - Chemical Shift-Splitting – Coupling Constant.

UNIT III: Electrochemistry and Applications

Electrodes –electrochemical cell, Nernst equation, cell potential calculations(emf formula). Primary cells – Zinc-air battery, Secondary cells – Nickel-Cadmium (NiCad),and lithiumion batteries- working principle of the batteries including cell reactions; Fuel cells-Basic Concepts, the principle and working of hydrogen-oxygen Fuel cell.

Corrosion: Introduction to corrosion, electrochemical theory of corrosion, differential aeration cell corrosion, galvanic corrosion, metal oxide formation by dry and electrochemical corrosion, Pilling Bedworth ratios and uses, Factors affecting the corrosion, cathodic (sacrificial anodic protection and impressed current cathodic protection) and anodic protection (working principle), electroplating and electro less plating (Nickel and Copper).

UNIT IV: Polymers and Fuel Chemistry

Introduction to polymers, functionality of monomers, Mechanism of chain growth, step growth polymerization. Thermoplastics and Thermo-setting plastics-: Preparation, properties and applications of poly styrene. PVC, Nylon 6,6 and Bakelite. Elastomers – Preparation, properties and applications of Buna S, Buna N, Thiokol rubbers

Fuels – Types of fuels, calorific value of fuels (HCV, LCV and Theoretical calculations of calorific value), numerical problems based on calorific value;Analysis of coal (Proximate and Ultimate analysis), Liquid Fuels, refining of petroleum, Octaneand Cetane number- alternative fuels- propane, methanol, ethanol and bio fuel-bio diesel.

UNIT V: Modern Engineering Materials

Composites- Definition, Constituents, Classification- Particle, Fibre and Structural reinforced composites, properties and Engineering applications

Refractories- Classification, Properties, Factors affecting the refractory materials and Applications.

Lubricants- Classification, Functions of lubricants, Mechanism, Properties of lubricating oils – Viscosity, Viscosity Index, Flash point, Fire point, Cloud point, saponification and Applications.

Building materials- Portland Cement, constituents, Setting and Hardening of cement.

Textbooks:

1. Jain and Jain, Engineering Chemistry, 16/e, DhanpatRai, 2013.

2. Peter Atkins, Julio de Paula and James Keeler, Atkins' Physical Chemistry, 10/e, Oxford University Press, 2010.

Reference Books:

1. H.F.W. Taylor, Cement Chemistry, 2/e, Thomas Telford Publications, 1997.

2. D.J. Shaw, Introduction to Colloids and Surface Chemistry, Butterworth-Heineman, 1992.

3. Textbook of Polymer Science, Fred W. Billmayer Jr, 3rd Edition

R23 - B. Tech. - ME **I Year B. Tech. II Semester**

ENGINEERING MECHANICS
(Common for CE/ME/EEE)

Subject Code: 23EST104

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To get familiarized with different types of force systems.
- To draw accurate free body diagrams representing forces and moments acting on a body to analyze the equilibrium of system of forces.
- To teach the basic principles of center of gravity, centroid and moment of inertiaand determine them for different simple and composite bodies.
- To apply the Work-Energy method to particle motion.
- To understand the kinematics and kinetics of translational and rotational motion ofrigid bodies.

COURSE OUTCOMES: Upon successful completion of the course the students will be able to

CO1: Understand the fundamental concepts in mechanics and determine the frictional forces for bodies in contact.
CO2: Analyze different force systems such as concurrent, coplanar and spatial systems and calculate their resultant forces and moments.
CO3: Calculate the centroids, center of gravity and moment of inertia of different geometrical shapes.
CO4: Apply the principles of work-energy and impulse-momentum to solve the problems of rectilinear and curvilinear motion of a particle.
CO5: Solve the problems involving the translational and rotational motion of rigid bodies.

UNIT -I

Introduction to Engineering Mechanics: Basic Concepts. Scope and Applications

Systems of Forces: Coplanar Concurrent Forces– Components in Space–Resultant– Moment of Force and its Application –Couples and Resultant of Force Systems.

Friction: Introduction, limiting friction and impending motion, Coulomb's laws of dry friction, coefficient of friction, Cone of Static friction.

UNIT -II

Equilibrium of Systems of Forces: Free Body Diagrams, Lami's Theorm, Equations of Equilibrium of Coplanar Systems, Graphical method for the equilibrium, Triangle law of forces, converse of the law of polygon of forces condition of equilibrium, Equations of Equilibrium for Spatial System of

concurrent forces, Numerical examples on spatial system of concurrent forces using vector approach, Analysis of plane trusses.

UNIT- III

Centroid: Centroids of simple figures (from basic principles)–Centroids of Composite Figures. **Centre of Gravity:** Centre of gravity of simple body (from basic principles), Pappus theorems.

Area Moments of Inertia: Definition– Polar Moment of Inertia, Transfer Theorem, Moments of Inertia of Composite Figures, Products of Inertia, Transfer Formula for Product of Inertia.

Mass Moment of Inertia: Moment of Inertia of Masses, Transfer Formula for Mass Moments of Inertia.

UNIT -IV

Rectilinear and Curvilinear motion of a particle: Kinematics and Kinetics – D'Alembert's Principle - Work Energy method and applications to particle motion-Impulse Momentum method.

UNIT -V

Rigid body Motion: Kinematics and Kinetics of translation, Rotation about fixed axis and plane motion, Work Energy method and Impulse Momentum method.

Textbooks:

1. Engineering Mechanics, S. Timoshenko, D. H. Young, J.V. Rao, S. Pati., , McGraw Hill Education 2017. 5th Edition.
2. Engineering Mechanics, P.C.Dumir- S.Sengupta and Srinivas V veeravalli , University press. 2020. First Edition.
3. A Textbook of Engineering Mechanics, S.S Bhavikatti. New age international publications 2018. 4th Edition.

Reference Books:

1. Engineering Mechanics, Statics and Dynamics, Rogers and M A. Nelson., McGraw Hill Education. 2017. First Edition.
2. Engineering Mechanics, Statics and Dynamics, I.H. Shames., PHI, 2002. 4th Edition.
3. Engineering Mechanics, Volume-I: Statics, Volume-II: Dynamics, J. L. Meriam and L.G. Kraige., John Wiley, 2008. 6th Edition.
4. Introduction to Statics and Dynamics, Basudev Battachatia, Oxford University Press, 2014. Second Edition
5. Engineering Mechanics: Statics and Dynamics, Hibbeler R.C., Pearson Education, Inc., New Delhi, 2022, 14th Edition

R23 - B. Tech. - ME **I Year B. Tech. II Semester**

THERMODYNAMICS

Subject Code: 23MET101

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To introduce the concepts of heat, work, energy and governing rules for conversion of one form to other.
- To explain relationships between properties of matter and basic laws of thermodynamics.
- To teach the concept of entropy for identifying the disorder and feasibility of a thermodynamic process.
- To introduce the concept of available energy for maximum work conversion.
- To provide fundamental concepts of air standard cycles used in IC engines.

COURSE OUTCOMES: Upon the completion of this course, the students will be able to

CO 1: Understand and apply basic concepts of Thermodynamics

CO2: Understand and apply the first law of Thermodynamics for open and closed systems under steady conditions.

CO 3: Understand and apply Second law of Thermodynamics for Heat engines and Heat pumps. Understand the concept of entropy in a system undergoing any Thermodynamic process.

CO4: Calculate available and unavailable energies for steady flow process and Non-flow process, Understand and derive Thermodynamic relations.

CO 5: Establish an expression for mean effective pressure and thermal efficiency for different thermodynamic cycles and compare their performance.

UNIT-I

Introduction to Thermodynamics: Macroscopic versus Microscopic View point Thermodynamic System and control volume, Thermodynamic Properties, processes and cycles, Thermodynamic equilibrium, Quasi-Static Process, Concept of Continuum, Zeroth Law of Thermodynamics, Reversible and Irreversible Processes.

Work and Heat Transfer: Work Transfer, pdV Work, pdV Work in Various Quasi-Static Processes, Free expansion, Heat Transfer.

UNIT-II

First Law of Thermodynamics: First Law of Thermodynamics and Internal energy, PMM1, Corollaries of First Law of Thermodynamics.

First Law Applied to Flow Systems: Steady Flow process, Steady Flow Energy Equation, SFEE applied to Nozzle and Diffuser, Turbine and Compressor, Heat Exchanger.

UNIT-III

Second Law of Thermodynamics: Limitations of First law, Kelvin-Planck statement –Cyclic Heat Engine, Clausius' statement, Refrigerator and Heat Pump, Equivalence of Kelvin-Planck and Clausius' Statement, Carnot Cycle, Carnot's Theorem.

Entropy: Clausius' Theorem, The property of entropy, The Inequality of Clausius, Concept of entropy-Entropy Principle, Third Law Thermodynamics.

UNIT-IV

Exergy: AE Referred to cycle – Decrease in AE when heat transfer through Finite Temperature Difference, Exergy of a finite body at temperature T, Maximum work in Reversible Process, Exergy of a Closed system, Exergy of a Steady flow system.

Gas Laws & Thermodynamic Relations: Avagadro's law, Equation of state of gas, Ideal gas, Maxwell's Equations, TdS Equations, Difference in Heat Capacities, Ratio of Heat Capacities..

UNIT-V

Thermodynamic Cycles: Otto cycle, Diesel cycle, Dual Combustion cycle, Mean Effective Pressure for Otto, Diesel, and Dual cycle, Comparison of Otto, Diesel, and Dual cycle.

TEXT BOOKS:

1. Engineering Thermodynamics, P.K. Nag, Tata McGraw-Hill Publications.
2. Thermal Engineering, R.K. Rajput, S.Chand Publications.
3. Thermodynamics: An Engineering Approach, Michael A. Boles and Yungus A. Cengel, Tata McGraw-Hill Publications.
4. Arora C.P, "Thermodynamics", Tata McGraw-Hill, New Delhi, 2003.

REFERENCES BOOKS:

1. Thermal Engineering, P.L. Ballaney, Khanna Publications,
2. Thermal Engineering, M.L.Mathur, F.S.Mehta, Jain Brothers Publications,
3. Introduction to Thermodynamics, J.B.Jones, G.A.Hawkins, John Wiley Publications,
4. Fundamentals of Thermodynamics, Gordon John Van Wylen, Richard Edwin Sonntag, John Wiley Publications

R23 - B. Tech. - ME **I Year B. Tech. II Semester**

ENGINEERING WORKSHOP

(Common to ME/CE/ECE/EEE)

Subject Code: 23ESL104

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

To familiarize students with wood working, sheet metal operations, fitting and electrical house wiring skills

COURSE OUTCOMES: Upon the completion of this course, the students will be able to
CO1: Identify workshop tools and their operational capabilities.
CO2: Practice on manufacturing of components using workshop trades including fitting, carpentry, foundry and welding.
CO3: Apply fitting operations in various applications.
CO4: Apply basic electrical engineering knowledge for House Wiring Practice
CO5: Apply the Plumbing tools in plumbing operations

SYLLABUS

1. **Demonstration**: Safety practices and precautions to be observed in workshop.
2. **Wood Working:** Familiarity with different types of woods and tools used in wood working and make following joints.

a) Half - Lap joint b) Mortise and Tenon joint c) Corner Dovetail or Bridle joint

3. **Sheet Metal Working**: Familiarity with different types of tools used in sheet metal working, Developments of following sheet metal job from GI sheets.

a) Tapered tray b) Conical funnel c) Elbow pipe d) Brazing

4. **Fitting:** Familiarity with different types of tools used in fitting and do the following fitting exercises.

a) V-fit b) Dovetail fit c) Semi-circular fit d) Bicycle tire puncture and change of two-wheeler tyre

5. **Electrical Wiring**: Familiarity with different types of basic electrical circuits and make the following connections.

a) Parallel and series b) Two-way switch c) Godown lighting
d) Tube light e) Three phase motor f) Soldering of wires

6. **Foundry Trade:** Demonstration and practice on Moulding tools and processes, Preparation of Green Sand Moulds for given Patterns.

7. **Welding Shop**: Demonstration and practice on arc welding and gas welding. Preparation of Lap joint and Butt joint.

8. **Plumbing:** Demonstration and practice of Plumbing tools, Preparation of Pipe joints with coupling for same diameter and with reducer for different diameters.

Textbooks:

1. Basic Workshop Technology: Manufacturing Process, Felix W.; Independently Published,2019. Workshop Processes, Practices and Materials; Bruce J. Black, Routledge publishers, 5th Edn. 2015.
2. A Course in Workshop Technology Vol I. & II, B.S. Raghuwanshi, Dhanpath Rai & Co., 2015 & 2017.

Reference Books:

1. Elements of Workshop Technology, Vol. I by S. K. Hajra Choudhury & Others, MediaPromoters and Publishers, Mumbai. 2007, 14th edition
2. Workshop Practice by H. S. Bawa, Tata-McGraw Hill, 2004.
3. Wiring Estimating, Costing and Contracting; Soni P.M. & Upadhyay P.A.; AtulPrakashan, 2021-22.

R23 - B. Tech. - ME **I Year B. Tech. II Semester**

COMMUNICATIVE ENGLISH LAB

(Common to All Branches of Engineering)

Subject Code: 23BHL101

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES

- To enable students to cultivate proper speech habits
- To enhance the ability of students to make extempore speeches
- To help students master techniques of being successful in debates and group discussions
- To assist students to acquire effective and adequate presentation skills
- To prepare students to face interviews in an assertive manner

COURSE OUTCOMES

CO 1: Students will be able to pronounce words accurately.
CO 2: Students will be able to speak spontaneously.
CO 3: Students will be able to participate in debates and group discussions and contribute proactively.
CO 4: Students will be able to present data on select topics using pre-existing slides.
CO 5: Students will be able to face interviews confidently.

UNIT I: Phonetics — Neutral English Accent
UNIT II: JAM session — Role play
UNIT III: Debate — Group Discussion
UNIT IV: Poster Presentation — PPT Presentations
UNIT V: Cover letter — Résumé — Interview Skills

Suggested Software:

- Walden InfoTech
- Young India Films

Reference Books:

1. Meenakshi Raman, Sangeeta-Sharma. Technical Communication. Oxford Press. 2018.
2. Samson T : Innovate with English, Foundations
3. Grant Taylor: English Conversation Practice, Tata McGraw-Hill Education India, 2016.
4. Jayashree, M Let's Hear them Speak: Developing Listening-Speaking skills in English. Sage Publications.
5. Hewing's, Martin. Cambridge Academic English (B2). CUP, 2012.
6. T. Balasubramanyam, A Textbook of English Phonetics for Indian Students, (3rd Ed.) Trinity Press.

Web Resources:

Spoken English:

1) www.esl-lab.com
2) www.englishmedialab.com
3) www.englishinteractive.net
4) https://www.britishcouncil.in/english/online
5) http://www.letstalkpodcast.com/
6) https://www.youtube.com/c/mmmEnglish_Emma/featured
7) https://www.youtube.com/c/ArnelsEverydayEnglish/featured
8) https://www.youtube.com/c/engvidAdam/featured
9) https://www.youtube.com/c/EnglishClass101/featured
10) https://www.youtube.com/c/SpeakEnglishWithTiffani/playlists
11) https://www.youtube.com/channel/UCV1h_cBE0Drdx19qkTM0WNw
12) https://www.linguahouse.com/en-GB
13) https://www.ted.com/watch/ted-ed

Voice & Accent:

1) https://www.youtube.com/user/letstalkaccent/videos
2) https://www.youtube.com/c/EngLanguageClub/featured
3) https://www.youtube.com/channel/UC_OskgZBoS4dAnVUgJVexc
4) https://www.youtube.com/channel/UCNfm92h83W2i2ijc5Xwp_IA

R23 - B. Tech. - ME **I Year B. Tech. II Semester**

ENGINEERING CHEMISTRY LAB

(Common to ME/CE)

Subject Code: 23BHL104

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

- To verify the fundamental concepts with experiments

COURSE OUTCOMES: At the end of the course, the students will be able to

CO1: Determine the cell constant, conductance, potential and pH of solutions.

CO2: Prepare advanced polymer Bakelite materials.

CO3: Determine the molecular/system properties such as kinematic viscosity, Flash and fire point and acid number etc.

CO4: Estimate the Iron (by colurimeter) and Calcium in cement.

CO5: Measure molecular/system properties such as chloride content, hardness of water, dissolved oxygen, of surface tension and viscosity etc

List of Experiments:

1. Determination of Hardness of a groundwater sample.
2. Estimation of Dissolved Oxygen by Winkler's method
3. Determination of Strength of an acid in Pb-Acid battery.(P^{H}METRY)
4. Preparation of a polymer (Bakelite)
5. Determination of percentage of Iron sample by colorimetry
6. Estimation of Calcium in port land Cement
7. Preparation of nanomaterials by precipitation method.
8. Adsorption of acetic acid by charcoal
9. Determination of percentage Moisture content in a coal sample
10. Determination of Viscosity of lubricating oil by Redwood Viscometer 1
11. Determination of Viscosity of lubricating oil by Redwood Viscometer 2
12. Determination of Calorific value of gases by Junker's gas Calorimeter
13. Conductometric titration of strong acid vs. strong base.
14. Potentiometry - determination of redox potentials and emfs.
15. Determination of surface tension and viscosity.
16. Determination of acid number of lubricating oil.
17. Determination of flash and fire point of lubricating oil.

Reference: "Vogel's Quantitative Chemical Analysis 6th Edition 6th Edition" Pearson Publications by J. Mendham, R.C. Denney, J.D. Barnes and B. Sivasankar

R23 - B. Tech. - ME **I Year B. Tech. II Semester**

HEALTH AND WELLNESS, YOGA AND SPORTS

(Common to All Branches of Engineering)

Subject Code: 23MCS103

L	T	P	C
0	0	1	0.5

Course Objectives:

The main objective of introducing this course is to make the students maintain their mental and physical wellness by balancing emotions in their life. It mainly enhances the essential traits required for the development of the personality.

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

CO1: Understand the importance of yoga and sports for Physical fitness and sound health.
CO2: Demonstrate an understanding of health-related fitness components.
CO3: Compare and contrast various activities that help enhance their health.
CO4: Assess current personal fitness levels.
CO5: Develop Positive Personality

UNIT I

Concept of health and fitness, Nutrition and Balanced diet, basic concept of immunity Relationship between diet and fitness, Globalization and its impact on health, Body Mass Index (BMI) of all age groups.

Activities:

i) Organizing health awareness programmes in community
ii) Preparation of health profile
iii) Preparation of chart for balance diet for all age groups

UNIT II

Concept of yoga, need for and importance of yoga, origin and history of yoga in Indian context, classification of yoga, Physiological effects of Asanas- Pranayama and meditation, stress management and yoga, Mental health and yoga practice.

Activities:

Yoga practices – Asana, Kriya, Mudra, Bandha, Dhyana, Surya Namaskar

UNIT III

Concept of Sports and fitness, importance, fitness components, history of sports, Ancient and Modern Olympics, Asian games and Commonwealth games.

Activities:

i) Participation in one major game and one individual sport viz., Athletics, Volleyball, Basketball, Handball, Football, Badminton, Kabaddi, Kho-kho, Table tennis, Cricket etc.
Practicing general and specific warm up, aerobics
ii) Practicing cardiorespiratory fitness, treadmill, run test, 9 min walk, skipping and running.

Reference Books:

1. Gordon Edlin, Eric Golanty. Health and Wellness, 14th Edn. Jones & Bartlett Learning, 2022
2. T.K.V.Desikachar. The Heart of Yoga: Developing a Personal Practice
3. Archie J.Bahm. Yoga Sutras of Patanjali, Jain Publishing Company, 1993
4. Wiseman, John Lofty, SAS Survival Handbook: The Ultimate Guide to Surviving Anywhere Third Edition, William Morrow Paperbacks, 2014
5. The Sports Rules Book/ Human Kinetics with Thomas Hanlon. -- 3rd ed. Human Kinetics, Inc.2014

General Guidelines:

1. Institutes must assign slots in the Timetable for the activities of Health/Sports/Yoga.
2. Institutes must provide field/facility and offer the minimum of five choices of as many as Games/Sports.
3. Institutes are required to provide sports instructor / yoga teacher to mentor the students.

- **Evaluation Guidelines:**
- Evaluated for a total of 100 marks.
- A student can select 6 activities of his/her choice with a minimum of 01 activity per unit. Each activity shall be evaluated by the concerned teacher for 15 marks, totalling to 90 marks.
- A student shall be evaluated by the concerned teacher for 10 marks by conducting viva voce on the subject.

AR23– B. Tech. – ME **II Year B. Tech., I Semester**

NUMERICAL METHODS

(Common to ME, CE)

L	T	P	C
3	0	0	3

Subject Code: 23BHT209

COURSE OBJECTIVES

- Apply various numerical methods to solve algebraic and transcendental equations.
- Determine the dependent variable at a given point (x) by using numerical techniques to approximate the unknown function y = f(x), considering both evenly and unevenly spaced data points.
- Use different numerical approaches to estimate derivatives accurately.
- Utilize numerical methods to compute definite integrals.
- Implement numerical methods to solve ordinary differential equations effectively

COURSE OUTCOMES: Upon completing this course, students will be able to,

CO1: Identify appropriate numerical methods to solve algebraic and transcendental equations.
CO2: Use numerical techniques to approximate the dependent variable at a specific point (x) by estimating the unknown function y = f(x), considering both evenly and unevenly spaced points.
CO3: Utilize various numerical methods to approximate derivatives
CO4: Compute definite integrals, as well as solve initial value problems.
CO5: Calculate the numerical solution for ordinary differential equations using suitable methods.

Unit – I
Algebraic and Transcendental Equations (10 hrs)
Solution of Algebraic and Transcendental Equations: Introduction – The Bisection Method – The Method of False Position – The Iteration Method – Newton-Raphson Method.

Unit-II
Interpolation (10 hrs)
Interpolation**:** Introduction – Finite differences- Forward Differences – Backward differences – Central differences -Relation between different operators- Newton's Interpolation formulae –Gauss Interpolation Formulae- Interpolation with unevenly spaced points – Lagrange's Interpolation formula.

Unit-III

Numerical Differentiation (8 hrs)

Numerical Differentiation– Differentiation using finite differences- Newton's Forward – Backward- Lagranges- Stirling's formula-Lagrange's interpolation formula.

UNIT-IV

Numerical Integration (8 hrs)

Numerical Integration – Trapezoidal rule – Simpson's 1/3 Rule –Simpson's 3/8 Rule.
Numerical double integration - Trapezoidal rule – Simpson's 1/3 Rule.

Unit-V

Numerical solution of Ordinary Differential equations (10hrs)

Solution by Taylor's series – Picard's Method of successive Approximations – Euler's Method – Runge – Kutta Method (4^{th} order).

Text Books:

1. Higher Engineering Mathematics, B. S. Grewal, Khanna Publishers, New Delhi, 42^{nd} edition, 2012.
2. A Text Book on Mathematical Methods, Ravindranath, V. and Vijayalaxmi, A.,Himalaya Publishing House, Bombay, 2^{nd} edition, 2012.

Reference Books:

1. Engineering Mathematics Vol.2.-Mathematical Methods (JNTU Kakinada), Dr.T. K.V.Iyengar, Dr.M.V.S.S.N.Prasad, S.Ranganatham, Dr.B.Krishna Gandhi, , S. Chand Publications.

2. Engineering Mathematics, B. V. Ramana, Tata McGraw Hill, New Delhi.

AR23– B. Tech. – ME **II Year B. Tech., I Semester**

PYTHON PROGRAMMING

L	T	P	C
3	0	0	3

Subject Code: 23EST206

COURSE OBJECTIVES:

Python programming course aims to empower students with the knowledge, skills, and practical experience essential for becoming proficient Python programmers. By mastering Python fundamentals, exploring its rich ecosystem, and learning software development best practices, students develop problem-solving abilities and gain the confidence to tackle real-world challenges.

COURSE OUTCOMES: At the end of the course, the student will be able to:

CO1: Examine Python syntax and semantics and be fluent in the use of Python flow control and functions.

CO2: Demonstrate proficiency in handling Strings and File Systems.

CO3: Create, run and manipulate Python Programs using core data structures like Lists, Dictionaries and use Regular Expressions.

CO4: Implement file handling functions and user defined functions in python.

CO5: Interpret the concepts of Object-Oriented Programming as used in Python and Regular Expressions.

Unit – I

Introduction to Python: History, Features, Installing Python, Running Python, Operators, Statements and Expressions.

Control Structures: Conditional Statements, Loops

Unit – II

Data Types: Mutable vs immutable data type, Numbers - Introduction to Numbers, Integers, Floating Point Real Numbers, Complex Numbers, Operators, Built-in Functions, Related Modules. Sequences - Strings, Lists, and Tuples, Dictionaries and Set Types

Unit – III

Functions: Definitions, Declaration, Parameter passing, calling functions

File Handling: creating a file, opening a file, I/O with file (read, write, append), closing a file

Unit – IV

Modules: Modules and Files, Namespaces, Importing Modules, Importing Module Attributes, Module Built-in Functions, Packages, Other Features of Modules.

Unit – V

Classes in Python: Principles of Object Orientation, Creating Classes, Instance Methods, Special Methods, class Variables and Inheritance, Data base connectivity.

Regular Expressions: Introduction, Special Symbols and Characters, Res and Python

Textbooks:

1. Wesley J .C hun "Core Python Applications Programming", 3rd Edition, 2012, Prentice Hall.
2. Brian jones, David Beazley “Python Cookbook ”, 3rd Edition.

Reference Books:

1. Mark Lutz "Programming Python, 4th Edition" O'Reilly Media.
2. Think Python, Allen Downey, Green Tea Press

Reference Links:

1. https://docs.python.org/3/tutorial/index.html
2. https://pythonprogramminglanguage.com

AR23– B. Tech. – ME **II Year B. Tech., I Semester**

MATERIALS ENGINEERING

Subject Code: 23MET202

L	T	P	C
2	0	0	2

COURSE OBJECTIVES:

Graduates from this program will:

- Provides a basic knowledge about the material properties and testing methods along with crystal structures and deformations.
- Explains the importance of phase diagrams and study of various binary phase diagrams.
- To understand concept and applications of Ferrous, Non-Ferrous metals & alloys
- Conveys the significance of various heat treatment processes and their effect on properties of steel
- Explains concept of powder metallurgy and process of testing of materials

COURSE OUTCOMES: On completion of this course, students should be able to

CO 1: Gain comprehensive knowledge in engineering materials and their structures.
CO 2: Construct Fe-C equilibrium diagram and Differentiate phase diagrams in binary systems.
CO 3: Become familiar with Cast Iron, Steel, and Aluminium materials along withtheir uses and applications.
CO 4: Know the purpose of heat treatment and Recognize various heat treatment processes.
CO 5: State the necessity of making components using powder metallurgy and material testing methods.

UNIT-I

Structure of Metals: Bonds in Solids: Ionic bond, Covalent bond, Metallic bond, Vander waal's forces, and characteristic of a metallic bond, **Bravais Lattice**: various viewpoints, Coordination number, **Atomic packing factor**: Simple cubic, Body centred cubic, Face centred cubic, and Hexagonal closed packing.

Imperfection (Defects) in crystals: Point, line, Surface and Volume, Mechanisms/modes of plastic deformation: Slip, Role and Significance of Dislocations, Twinning, Crystallization of metals, grain and grain boundaries, effect of grain boundaries, grain size determination.

UNIT-II

Constitution of Alloys: Classification and necessity of alloying, types of solid solutions, Hume Rotherys rules, intermediate alloy phases, and electron compounds.

Phase Diagrams: Construction of phase diagrams, Binary Phase diagrams (Isomorphous alloy systems), Lever rule, and Eutectic Phase diagram, Mechanism of Crystallization, **Cooling Curves:** Solidification under Equilibrium and Non-Equilibrium for Binary and Eutectic, Study of **Iron-Iron carbide (Fe-Fe_3C) phase diagram** and Characteristics of phases appeared in Fe-Fe3C phase diagram.

UNIT-III

Cast Irons and Steels: Classification of cast iron, Structure, properties and application of White Cast iron, Malleable Cast iron, grey cast iron, Spheriodal graphite cast iron, Alloy cast irons.

Steels: Purpose of Alloying, Characteristics and effects, Classification of steels based on % of Carbon: Low alloy, and High alloy, Tools steels and their uses, Merits and demerits of ceramic tools and die steels.

UNIT-IV

Heat treatment of steels: Classification of heat treatments, Stages and cooling methods: Annealing, normalizing, Hardening, and Tempering, TTT diagrams, martempering &aus-tempering, **Surface hardening methods:** Flame Hardening, Induction Hardening, **Diffusion Hardening:** Carburizing, Nitriding**, Mechanical Treatment: hot working, cold working of steels.**

UNIT-V

Powder Metallurgy: Characteristics of metal powders, Production of metallic powders: Gas atomization, water atomization, and centrifugal atomization, Design considerations, Secondary and Finishing Operations, component preparation stages, advantages, limitations and applications.

Mechanical Properties and Testing: Concepts of Stress & Strain, Tensile Test: Stress-Strain Curves for Ductile Materials, Hardness Testing: Rockwell, Brinell and Vickers, Toughness Testing: Charpy, Izod tests, factors affecting impact energy, creep, fatigue tests and factors affecting fatigue life.

TEXT BOOKS:

1. W. D. Callister, 2006, “Materials Science and Engineering-An Introduction”, 6th Edition, Wiley India.
2. V. Raghavan, "Material Science and Engineering" , 2nd edition, Prentice Hall of India Private Limited, 1999.
3. Sidney H. Avener,"Introduction to Physical Metallurgy", Mc Graw Hill, 1974.

REFERENCE BOOKS:

1. Alan Cottrell, "An introduction to Metallurgy", second edition universities press (India) private limited, 2000.
2. Kenneth G. Budinski and Michael K. Budinski, “Engineering Materials”, 2nd edition, Prentice Hall of India Private Limited, 4th Indian Reprint, 2002.
3. B K Agarwal, “Science of Engineering Materials, Introduction to Engineering Materials”, McGraw Hill Education, 2017.
4. R. K. Rajput, Engineering materials and metallurgy, S. Chand,2015.

AR23– B. Tech. – ME **II Year B. Tech., I Semester**

MECHANICS OF SOLIDS

Subject Code: 23MET203

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To compute normal stresses and strains in bars of varying sections and composite bars subjected to external loads and temperature changes.
- To plot shear force and bending moment diagrams.
- To determine shear stresses and bending stresses in beams of circular, rectangular I and T cross-sections & torsional shear stresses in shafts.
- To compute deflection of beams.
- To calculate crippling load for columns.

COURSE OUTCOMES: On completion of this course, students should be able to

CO1: Compute normal stresses and strains in bars of varying sections and composite bars subjected to external loads and temperature changes.
CO2: Compute shear force and bending moment for statically determinate cantilever or simply-supported beams subjected to various loads.
CO3: Determine flexural stresses and shear stresses in beams of circular, rectangular I, T and channel cross-sections & torsional shear stresses in circular and hollow circular shafts.
CO4: Compute beam deflections using double integration and moment-area methods.
CO5: Calculate the crippling load for a column with different end conditions.

UNIT-I

Simple Stresses & Strains

Types of stresses and strains, Hooke's law, Stress-strain diagram for mild steel, working stress, Factor of safety, Lateral strain, Poisson's ratio, Bars of varying section, Bars subjected to different loads at different cross sections.

Stresses in composite bars, Temperature stresses, Elastic Constants and relationship between them.

UNIT-II

Shear Force & Bending Moment

Definition of beam, Types of beams, Concept of shear force (SF) and bending moment (BM), SF and BM diagrams for cantilever, simply supported and overhanging beams subjected to point loads, uniformly distributed load, uniformly varying loads& combination of these loads, Point of contra-flexure, Relationship between S.F, B.M, and rate of loading at a section of a beam.

UNIT-III

Flexural Stresses

Theory of simple bending, Assumptions, Derivation of bending equation $M/I = \sigma/y = E/R$, Neutral axis, Determination bending stresses, Section modulus of rectangular and circular sections (solid and hollow), I, T and Channel sections.

Shear Stresses

Governing equation for shear stress, Shear stress distribution across rectangular, circular, I and channel cross-sections. Shafts Subjected to pure torsion, Torsion equation, Torsional rigidity, Comparison of solid and hallow shafts.

UNIT-IV

Deflection of Beams

Bending into a circular arc- Slope, deflection and radius of curvature, Differential equation for the elastic line of a beam, Double integration method, Determination of slope and deflection for cantilever and simply supported beams subjected to point loads and uniformly distributed loads, Moment area method, application to cantilever and simply supported beams.

UNIT-V

Theory of Columns

Definition, classification and strength of columns, Euler‘s formula for long columns, Derivations of Euler‘s formula for different end conditions, Limitations and Euler’s formula, Rankine‘s Hypothesis for columns. Columns subjected to eccentric loading, Secant Formula.

Text Books:

1. Strength of Materials, S. S. Bhavikatti, Lakshmi Publications.
2. Strength of Materials, R. K. Rajput, S.Chand Publications.

References Books:

1. Strength of Materials, S. S. Rattan, Tata McGraw Hill Publications.
2. Analysis of Structures Vol-I, Vazirani, Ratwani, Khanna Publications.
3. Mechanics of Materials, Ferdinand Beer, E. Russell Johnston, John DeWolf, David Mazurek, Tata McGraw Hill Publications.
4. Mechanics of Materials, B C Punmia, Laxmi publications.

AR23 – B. Tech. – ME **II Year B. Tech., I Semester**

FLUID MECHANICS AND HYDRAULIC MACHINERY

Subject Code: 23MET204

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To provide knowledge on different fluid properties and fluid flow.
- To provide basic knowledge on hydraulic turbines and pumps.

COURSE OUTCOMES: On completion of this course, students should be able to

CO 1: Define various physical properties of fluids, and understand how manometers are used to measure fluid pressure. List various flow classifications.
CO 2: Derive and solve problems based on continuity equation. Apply Euler, Bernoulli, Navier-Stokes, Impulse-momentum equations to solve practical fluid flow problems.
CO 3: Compute losses in fluid flow using Darcy Weisbach equation. Explain and solve problems based on various flow measurement devices.
CO 4: Estimate the efficiency & performance of turbines, select suitable turbine using characteristic curves, governing and cavitation and Illustrate mechanism & construction of various Hydraulic Turbines.
CO 5: Calculate efficiency and performance characteristics of centrifugal and reciprocating pumps.

UNIT-I

Introduction: Physical properties of fluids: Specific mass, Specific weight, Specific Volume – Specific gravity, Viscosity, Surface tension & Capillarity, Vapour pressure and Compressibility – Pressure: Pascal's law, Hydrostatic law, Atmospheric Gauge and Vacuum pressure –Measurement of pressure, Pressure gauges – Manometers: Simple & Differential manometers
Fluid Kinematics: Description of fluid flow: Path line, Streamline, Streakline, Streamtube, Velocity & Acceleration – Classification of fluid flows: Steady & Unsteady, Uniform & Non- uniform, Rotational & Irrotational flows – Reynolds Experiment: Laminar & Turbulent flows - Continuity equation for 1D, 2D and 3Dflows– Stream function, Velocity potential function and Flow net analysis.

UNIT-II

Fluid dynamics: Surface and Body forces – Euler's and Bernoulli's equations for flow along a stream line for 3D flow – Navier-Stokes equations (Explanation only) – Momentum equation and its

applications: Force on pipe bend– Flow between parallel plates, Flow through long tubes, Flow through inclined tubes

Measurement of flow: Pitot tube, Venturi meter and Orifice meter, Flow nozzle and Turbine flow meter

UNIT-III

Closed Conduit Flow: Darcy Weisbach equation – Minor losses in pipes: Pipes in series and pipes in parallel – Total energy line and Hydraulic gradient line

Impact of jet on vanes: Impact of jet on Flat, Inclined & Curved vanes (Stationary & Movable), Impact of jet on series of curved vanes

UNIT-IV

Hydraulic Turbines: Classification of turbines: Impulse and Reaction turbines – Pelton Wheel, Franci's turbine and Kaplan turbine – working proportions, work done, efficiencies, hydraulic design – Draft tube: Theory, functions and efficiency

Performance of hydraulic turbines: Geometric similarity – Unit and Specific quantities – Characteristic curves – Governing of turbines – Selection of type of turbine – Cavitation –Surge tanks – Water hammer

UNIT-V

Centrifugal pumps: Classification, working, and work done – Manometric head– Losses and efficiencies – Specific speed – Pumps in series and parallel – Performance curves – NPSH

Reciprocating pumps: Working, Discharge, Slip and indicator diagrams

Text Books:

1. Hydraulics, Fluid Mechanics and Hydraulic Machinery, P.N.Modi, S.M.Seth, Standard Book House Publications,
2. Fluid Mechanics and Hydraulic Machines, R.K.Rajput, S.Chand Publications,

Reference Books:

1. Fluid Mechanics and Fluid Power Engineering, D.S.Kumar, S.K.Kotaria& Sons Publications,
2. Fluid Mechanics and Machinery, D.Rama Durgaiah, NewAge Publications,
3. Hydraulic Machines,T.R.Banga, S.C.Sharma, Khanna Publications,
4. Instrumentation for Engineering Measurements, James W.Dally, WilliamE.Riley, John Wiley and Sons Publications,

AR23 – B. Tech. – ME **II Year B. Tech., I Semester**

PYTHON PROGRAMMING LAB

L	T	P	C
0	0	3	1.5

Subject Code: 23ESL207

COURSE OBJECTIVES:

This course will enable students with a comprehensive understanding of Python programming language, including its history, features, and fundamental concepts, enabling them to write Python programs proficiently.

COURSE OUTCOMES: At the end of the course, the student will be able to:

CO1: Able to implement conditional statements and loops to control the flow of their Python programs effectively.
CO2: To manipulate strings, lists, tuples, dictionaries, and sets using appropriate Python syntax and built-in functions.
CO3: To perform basic file operations such as creating, opening, reading, writing, appending, and closing files using Python.
CO4: To import specific attributes from modules, utilize built-in functions provided by modules, and organize modules into packages effectively.
CO5: Apply OOP concepts and regular expressions in Python to search, match, and manipulate textual data effectively.

Exercise Questions: 1
Ex 1: Write the python programs to implement all Number type operations.
Ex 2: Write the python programs to perform all String operations.

Exercise Questions: 2
Ex 3: Write the python programs to calculate the List datatype operations.
Ex 4: Write the python programs to perform the Dictionary operations.

Exercise Questions: 3
Ex 5: Write the python programs to implement the recursive function.
Ex 6: Write the python programs to perform the file operations.

Exercise Questions: 4
Ex 7: Write the python programs to implement modules and packages.

Exercise Questions: 5
Ex 8: Write the python program to create class, object and its concepts of OOP.
Ex 9: Write a Python program that uses regular expressions to find all occurrences of a specific pattern in a given text and validations.

Text Books

1. Wesley J .C hun "Core Python Applications Programming", 3rd Edition, 2012, Prentice Hall.
2. Brian jones, David Beazley “Python Cookbook ”, 3rd Edition.

References Books

1. Mark Lutz "Programming Python, 4th Edition" O'Reilly Media.

2. Think Python, Allen Downey, Green Tea Press

Web Links

1. https://docs.python.org/3/tutorial/index.html

2. https://pythonprogramminglanguage.com

MECHANICS OF MATERIALS AND METALLURGY LAB

Subject Code: 23MEL201

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

- To understand metallographic structures.
- To understand different material testing techniques.
- To find hardness, tensile strength and compressive strength of given specimens.

COURSE OUTCOMES: On completion of this course, students should be able to

CO 1: Determine metallographic structure of pure metals, cast irons, mild steels and alloys.
CO 2: Interpret effect of heat treatment on hardness of steels by using Jominy End Quench Test.
CO 3: Determine mechanical properties of given specimen using tension test, compression test, bending test, shear test on universal testing machine.
CO 4: Grade the specimen by conducting Izod and Charpy impact strength, Brinell and Rockwell hardness tests.
CO 5: Compute spring stiffness by measuring spring deformations for applied loads.

MECHANICS OF MATERIALS LAB

LIST OF EXPERIMENTS:

1. Direct tension test.
2. Bending test on simply supported beam and Shear test.
3. Torsion test.
4. Hardness tests:
   a) Brinell hardness test.
   b) Rockwell hardness test.
5. Test on springs/ Compression test on wooden cube
6. Impact test.
   a) Izod, b) Charpy.

METALLURGY LAB

LIST OF EXPERIMENTS:

1. Ball Models of SC/BCC/FCC/HCP
2. Preparation of any one specimen and metallographic observation of mild steel, low carbon steel, medium carbon steel, high carbon steel and high-speed steel.
3. Preparation of any one specimen and metallographic observation of white cast iron, grey cast iron and nodular iron.
4. Preparation of any one specimen and metallographic observation of pure metals like copper and aluminium.
5. Verify the effect of heat treatment on hardness of steels.
6. Hardenability measurement by Jominy End Quench test.

FLUID MECHANICS AND HYDRAULIC MACHINERY LAB

Subject Code: 23MEL202

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

- To give the practical exposure about fundamentals of fluid mechanics and hydraulics.
- To provide practical knowledge about the turbo-machinery.

COURSE OUTCOMES: On completion of this course, students should be able to

CO 1: Conduct impact of jet on vanes, and performance test on Pelton wheel.
CO 2: Conduct performance tests on Franci's turbine and Kaplan turbine.
CO 3: Conduct performance tests on single-stage and multi stage centrifugal pump and reciprocating pump.
CO 4: Calibrate Venturi meter and orifice-meter.
CO 5: Determine head loss and friction factor for a given pipeline.

LIST OF EXPERIMENTS

1. Calibration of Venturi meter
2. Calibration of Orifice meter
3. Impact of Jet on Vanes
4. Calibration of Turbine flow meter
5. Determination of Friction factor for a give closed conduit
6. Effect of minor losses in closed conduit flow
7. Performance test on Single-stage Centrifugal pump
8. Performance test on Multi-stage Centrifugal pump
9. Performance test on Reciprocating pump
10. Performance test on Pelton wheel
11. Performance test on Franci's turbine

Note: Conduct any 10 experiments from the given list

AR23 – B. Tech. – ME **II Year B. Tech., I Semester**

ENVIRONMENTAL STUDIES
(Common to all Branches)

Subject Code: 23MCT204

L	T	P	C
2	0	0	0

COURSE OBJECTIVES:

- Memorize the knowledge of environment and status of different resources on earth.
- Identify the significance, arrangement, causes of annihilation and conservation of ecosystems and bio-diversity.
- Discriminate causes, effects of a variety of pollutions and suitable control methods.
- Identify the hurdles of sustainable development; evaluate the different environmental management and legal issues.
- Describe the population growths, health problems and evaluate the environmental assets.

COURSE OUTCOMES: By Studying this Course Student will,

CO1: Recognize and speaks well again on the general issues of environment and know how to conserve resources for better usage.
CO2: Explain and demonstrate the ecosystems setup, assess. Recognize and conserving of diversity to upkeep.
CO3: Examine a range of pollution problems along with control and their eco-friendly disposal methods.
CO4: Translate the sustainable development practice through clean development mechanisms.
CO5: Evaluate the changing trends of world population and compile the information in order to document the environmental assets.

Unit – I (6 Hours)
Importance of Environmental Studies and Natural Resources: Definition of Environment – Importance - Need for Public Awareness
Forest Resources - Use and over exploitation - deforestation – consequences – case study
Water Resources - Use and over utilization - dams - benefits and problems on Tribes and Environment
Food Resources – Food security concept - changes caused by agriculture and overgrazing -effects of modern agriculture – fertilizer - pesticide problems - water logging - salinity – concept of sustainable agricultural methods - case study
Energy Resources - Non-renewable energy resources – coal – crude oil - natural gas - use of renewable and alternate energy sources

Unit – II (6 Hours)

Ecosystems and Biodiversity and its conservation: Definition – Structure of ecosystem: producers - consumers – decomposers. Functions of ecosystem: Food chains - food webs ecological pyramids - Energy flow – Nutrient cycles (Carbon cycle and Nitrogen cycle). Ecological succession.

Definition of Biodiversity - Values of biodiversity - Bio-geographical classification of India - Hot Spots of India - Endangered and endemic species of India –Threats to biodiversity - Conservation of biodiversity

Unit – III (6 Hours)

Environmental Pollution: Definition – causes - effects - control measures of Air pollution -Water pollution - Noise pollution – Marine Pollution - Nuclear hazards.

Solid waste Management: Causes - effects - disposal methods of urban waste – biomedical wastes - case studies

Disaster management: floods – earthquakes – cyclones

Unit – IV (6 Hours)

Social Issues and the Environment: Concept of Unsustainable and Sustainable development –Water conservation: Rain water harvesting- Watershed management – Global environmental challenges: climate change - global warming – acid rains - ozone layer depletion -World summits on environment: Stockholm conference – Rio-earth summit – Kyoto protocol – Environment (Protection) Act - Air (Prevention and Control of Pollution) Act – Water (Prevention and control of Pollution) Act - Wildlife (Protection) Act -Forest (Conservation) Act

Unit – V (4 Hours)

Human Population and the Environment: Population growth patterns - variation among nations - Population problems - control -Environment and human health - Role of information Technology in Environment and human health

Text Books:

1. Shashi Chawla. 2015, *A Text book of Environmental Studies*, Revised edition, TMH, New Delhi

2. Bharucha, E. 2005, *Text book of Environmental Studies*, First edition, Universities Press (India) Pvt. Ltd., Hyderabad

3. Suresh K. Dhameja. 2006-07, *Environmental Studies*, Third revised edition, S.K. Kataria & Sons (P) Ltd., New Delhi

4. Benny Joseph. 2015, *Environmental Studies*, Revised edition, TMH, New Delhi

Reference Books:

1. Odum, E.P, *Fundamentals of Ecology*, Third edition, W.B. Saunders & Co (P) Ltd., Philadelphia.

2. P. D. Sharma, *Ecology and Environment*, Revised edition, Rastogi Publications (P) Ltd.

3. Cunningham, W.P., Cunningham, M.A., *Principles of Environmental Science*, TMH, New Delhi.

4. Peavy, Rowe and Tchobanoglous, *Environmental Engineering*, Mc Graw – Hill International edition.

5. Graedel, T.E., Allenby, B.R., *Industrial Ecology and Sustainable Engineering*, Pearson Publications.

AR23 – B. Tech. – ME **II Year B. Tech., II Semester**

UNIVERSAL HUMAN VALUES
(Common to All Branches)

Subject Code:23BHT207

L	T	P	C
2	0	0	2

COURSE OBJECTIVES:

- To help the students appreciate the essential complementarity between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
- To facilitate the development of a Holistic perspective among students towards life, profession and happiness, based on a correct understanding of the Human reality and the rest of Existence.
- To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually satisfying human behaviour and mutually enriching interaction with Nature.
- To Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
- To facilitate the students in applying the understanding of harmony in existence in their profession and lead an ethical life

COURSE OUTCOMES: Upon completion of this course students can aware of

CO1: ethical behavior in the work place
CO2: To shapes the students by the end of this curriculum being harmony himself
CO3: To understand the human relationship and values
CO4: To understand the Nature and its existence of connectivity
CO5: Learn the importance of Human values and universal order

UNIT-I

Introduction: Understanding the need, basic guidelines, content and process for Value Education- Self Exploration - what is it? - Continuous Happiness and Prosperity Morals, Values and Ethics – Integrity – Work Ethics – Service Learning- Respect for others- Caring – Sharing – Honesty – Courage – Value time – Co-operation – Commitment Self-confidence – Spirituality.

UNIT-II

Understanding Harmony in the Human Being: Harmony in Myself! Understanding human being as a co-existence of the sentient 'I' and the material 'Body'- Understanding the needs of Self ('I') and 'Body'- Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)

UNIT-III

Understanding Harmony in the Family and Society: Harmony in Human-Human Relationship- Understanding harmony in the Family- the basic unit of human interaction Understanding values in human-human relationship- Trust (Vishwas) and Respect (Samman) as the foundational values of relationship- Understanding the meaning of Vishwas; Difference between intention and competence - Understanding the meaning of Samman, Difference between respect and differentiation; the other salient values in relationship

UNIT- IV

Understanding Harmony in the Nature and Existence: Whole existence as Co-existence- Understanding the harmony in the Nature- Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature- Holistic perception of harmony at all levels of existence

UNIT-V

Implications of the Holistic Understanding of Harmony: Natural acceptance of human values - Definitiveness of Ethical Human Conduct- Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order

Reference Books:

1. R. R. Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Human Values and Professional Ethics
2. “Professional Ethics and Human Values” by Prof. D.R. Kiran.
3. “Engineering Ethics & Human Values” by M.Govindarajan, S.Natarajan and V.S.SenthilKumar-PHI Learning Pvt. Ltd-2009.
4. A N Tripathy, 2003, Human Values, New Age International Publishers
5. R. Subramanian, Professional Ethics includes Human Values, Oxford Univ. Press
6. M Govindrajan, S Natrajan& V. S Senthilkumar, Engineering Ethics (including Humna Values), Eastern Economy Edition, Prentice Hall of India Ltd.

AR23 – B. Tech. – ME **II Year B. Tech., II Semester**

MANAGERIAL ECONOMICS AND FINANCIAL ANALYSIS

Subject Code: 23BHT213

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To provide the basic knowledge of economics, demand, supply.
- To measure the elasticity of demand and develop the ability of forecasting.
- Understanding of production and cost analysis.
- To create an awareness about the market conditions and knowledge of capital investment.
- To provide the basic knowledge of accounting, ratio analysis

COURSE OUTCOMES: On completion of this course, students should be able to

CO1: Learn demand analysis, demand determinants and law of demand and law of supply
CO2: Understand elasticity of demand, demand forecasting and its governing factors.
CO3: Understand theory of production and cost analysis.
CO4: Understand market structures and types of market competition and capital budgeting
CO5: Understand financial accounting including double-entry book keeping, journal, ledger and final accounts.

UNIT-I

Introduction to Managerial Economics: Definition, Types, nature and scope of managerial economics.
Demand Analysis: Definition, Demand determinants, Law of demand and its exceptions.
Supply Analysis: Definition, Supply determinants, Law of supply.

UNIT-II

Elasticity of Demand: Definition, Types of elasticity and types of price elasticity, measurement of elasticity.
Demand Forecasting: Definition, Factors governing demand forecasting – Methods of demand forecasting: Survey methods, Statistical methods, Expert opinion method, Test marketing, Judgmental approach to demand forecasting.

UNIT-III

Theory of Production: Production function – Isoquants and Isocosts, MRTS, Least cost combination of inputs – Cobb-Douglas production function, Laws of returns

Cost Analysis: Cost concepts – Break-Even Analysis (BEA), Determination of break-even point (Simple problems) Managerial significance and limitations of BEA.

UNIT-IV

Introduction to Market: Definition, Market structures, Types of competition, Features of perfect competition, Monopoly and monopolistic competition and Price determination.

Capital Budgeting: Project evaluation techniques-Traditional, modern methods, Payback period, ARR, NPV methods (simple problems).

UNIT-V

Introduction to Financial Accounting: Double-Entry book keeping, Journal, Ledger, Trial Balance – Final accounts (Trading account, Profit and loss account, Balance sheet with simple adjustments).

Introduction to Ratio Analysis: Different types of Ratio Analysis with simple problems.

TEXT BOOKS:

1. Managerial Economics and Financial Analysis, S.A. Siddiqui, A.S. Siddiqui, New Age Publications,
2. Managerial Economics, Varshney, Maheswari, Sultan Chand Publications,

REFERENCE BOOKS:

1. Managerial Economics and Financial Analysis, A.R. Aryasri, Tata McGraw Hill Publications,
2. Managerial Economics, D.N. Dwivedi, Vikas Publications,

AR23– B. Tech. – ME **II Year B. Tech., II Semester**

MANUFACTURING TECHNOLOGY - I

Subject Code: 23MET205

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand different manufacturing processes.
- To understand various tools, equipment and processes used in pattern making, mold and core making and foundry shop.
- To learn necessary details of various welding and allied joining processes such as gas welding, arc welding, resistance welding, brazing and soldering.
- To understand fundamental concepts related to forging and other mechanical working processes.

COURSE OUTCOMES: On completion of this course, students should be able to

CO 1: Identify elements of casting process including patterns, molding materials especially of sand, gating, riser, runner and melting furnaces.

CO2: Understand the working of different welding processes including arc, resistance and other processes along with their subtypes of welding.

CO3: Evaluate rolling process parameters, and understand the Extrusion and Drawing processes.

CO4: Classify forging and sheet metal working processes and understand the principle of working

CO5: Explain various high velocity forming processes and plastic injection and blow molding processes.

UNIT-I

Foundry: Introduction to casting process, Process steps, Advantages, Applications, Pattern types and pattern allowances – Molding materials, Importance of constituents, Molding tools and equipment.

Molding process: Sand molding types: Types of sands – CO_2molding – Shell molding.

Melting and Casting: Melting furnaces, Crucible furnace, Cupola, Other furnaces: Electrical, Induction furnaces, casting defects, Remedies.

Gating system: Elements of gating system, Gating system design, Calculation of gating system dimensions for simple objects, Riser design, chills and chaplets, solidification of casting.

Special Casting Processes: Precision Investment casting, Centrifugal casting, Permanent mould casting (Gravity Die casting), Die casting

UNIT-II

Welding: Fundamentals, classification of welding processes, types of welds, and types of joints.

Gas Welding: Equipment, oxy-acetylene flame, types, gas welding procedure, gas cutting.

ArcWelding: Principle of arc, Equipment, Electrodes, Shielded metal arc welding, Tungsten Inert Gas welding (TIG), Metal Inert Gas (MIG) welding, Mode of metal transfer in GMAW process, submerged arc welding.

Resistance Welding: Principle, Spot welding, Seam welding, Projection welding, Flash welding.

Other Welding Process: Laser beam welding, Thermit welding. Brazing, Braze welding, Soldering, Weld Defects.

UNIT-III

Forming: Fundamentals, Introduction to metal working process, Hot working, Cold working.

Rolling: Rolling fundamentals, Analysis of rolling process- Derivation of Length of deformation zone, Angle of bite, Maximum reduction possible for one pass, Rolling stand arrangements.

Extrusion & Drawing: Extrusion fundamentals, Classification of Extrusion- Forward Extrusion, Backward Extrusion, Impact extrusion, Hydrostatic extrusion. Types of drawing: Wire drawing, Tube drawing.

UNIT-IV

Forging: Fundamentals, Types of forging operations- Drawing out, upsetting. Forging types - Smith, Press, Drop forging.

Sheet Metal Working: Principles of sheet metal working, Punching and blanking. Types of Dies, Cup Drawing, Bending, Embossing, Coining.

UNIT-V

High Velocity Forming (HVF): Explosive forming, Magnetic pulse forming, Electro hydraulic forming. **High Energy Rate Forming (HERF)**

Plastics Processing: Types of plastics, Properties, Additives, Applications of plastics, Injection molding, Blow molding.

TEXT BOOKS:

1. Manufacturing Technology Vol-I, P.N.Rao, Tata McGraw Hill Publications
2. Production Technology, P. C. Sharma, S. Chand Publications

REFERENCES BOOKS:

1. Production Technology, R. K. Jain, Khanna Publications,
2. Elements of Workshop Technology Vol-II, S.K.HajraChoudhury, A.K.HajraChoudhury,
3. Nirjhar Roy, Media Promotors Publications,
4. Production Technology, Hindustan Machine Tools Publications,

AR23– B. Tech. – ME **II Year B. Tech., II Semester**

HEAT AND MASS TRANSFER

Subject Code: 23MET206

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand and apply the knowledge of conduction mode of heat transfer in steady and unsteady conditions
- To design the fin at desired locations for a specified heat transfer rate
- To understand the knowledge of free and forced mode of heat transfer
- To understand the boiling and condensation, and to design the heat exchanger
- To understand and apply the knowledge of radiation mode of heat transfer
- To understand the basics of mass transfer and analogy between heat transfer and mass transfer

COURSE OUTCOMES: On completion of this course, students would be able to

CO1: Estimate the plane & cylindrical wall thickness for a specified heat transfer rate and Estimate the insulating thickness in view of critical radius of insulation.
CO2: Calculate the Fin efficiency and effectiveness for a specified heat transfer rate and calculate the heat transfer rate for unsteady heat conduction by using Heisler's Charts.
CO3: Estimate the rate of heat transfer body under free and forced convection by using heat transfer coefficient, thermo-physical properties and non-dimensional numbers.
CO4: Analyze the heat exchanger by using LMTD and Effectiveness NTU methods.
CO5: Estimate the rate of heat exchange between two bodies through radiation and solve one-dimensional mass diffusion problems.

UNIT-I

Heat Transfer Mechanisms: Conduction, Convection, and Radiation.
Conduction-I: Fourier law of heat conduction - General heat conduction equation in Cartesian and cylindrical coordinates, Steady state heat Conduction through plane and cylindrical walls - Composite systems, Critical radius of insulation.

UNIT-II

Conduction-II: Heat Transfer through Fins - Infinite long fin, insulated at tip and convection heat transfer from tip, Fin equation for Heat transfer Efficiency and Effectiveness.
Transient Heat Conduction: Lumped System analysis, Use of Heisler's Charts.

UNIT-III

Natural Convection: Introduction to velocity and thermal boundary layers. - Nusselt number, Grashof Number, Prandtl Number and Reynolds Number, Flow over Horizontal and vertical plates.

Forced Convection: External Forced convection - Laminar and Turbulent flow over plates, Internal Forced convection - Laminar and Turbulent flow through pipes, Heat transfer coefficients.

UNIT-IV

Boiling and Condensation: Introduction to Boiling, Types of Boiling, Boiling curve. Introduction to condensation, types of condensation.

Heat Exchangers: Classification - Nature of heat exchange, direction of flow, mechanical design, physical state of fluid, Overall heat transfer coefficient, Heat Exchanger analysis - LMTD & Effectiveness NTU, Discussion on advancements in heat exchangers in industrial sectors.

UNIT-V

Radiation: Classification of Radiative bodies, Radiation Laws: Wein's law, Stefan-Boltzman law, Kirchhoff's law - Black body radiation, Shape factor - Radiation heat exchange between Gray bodies - Electrical analogy, Introduction to Reflective coating and Radiation shields to reduce radiation.

Mass Transfer: Basic modes of mass transfer, Mass Diffusion - Fick's Law of Diffusion - Steady state Mass Diffusion in one-dimension. Heat and Mass Transfer Analogy.

TEXT BOOKS:

1. Heat and MassTransfer, *Fundamentals and applications*, YunusA. Cengel and A.J.Ghajar, McGraw Hill Education
2. Fundamentals of Engineering Heat and Mass Transfer, R.C.Sachdeva, New Age Pub.
3. Heat Transfer Databook, C.P. Kothandaraman, New Age Pub.(**Permitted for Exams)**

REFERENCEBOOKS:

1. Heat and Mass Transfer, D.K.Dixit, McGraw Hill Education
2. Heat and Mass Transfer, P.K.Nag, McGraw Hill Education
3. Heat Transfer, JackP. Holman, McGraw Hill Education

AR23– B. Tech. – ME **II Year B. Tech., II Semester**

DESIGN OF MACHINE MEMBERS – I

Subject Code: 23MET207

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To compute Principal stresses in members subjected to combined loading and determine the dimensions of a mechanical component subjected to static loads using theories of elastic failure.
- To compute the dimensions of a component subjected to fatigue loads for finite and infinite life and calculate the dimensions of a bolted joint subjected to eccentric loading.
- To Design the size of a rivet and weld bead in riveted and welded joints subjected to axial and eccentric loads.
- To Design the diameter of a shaft supporting gears and pulleys and compute the dimensions of keys and shaft couplings subjected to torsional loading.
- To Design helical springs and leaf springs for static and fatigue loadings and analyze cotter joints and knuckle joint subject ted to axial loading.

COURSE OUTCOMES: On completion of this course, students should be able to

CO 1: Compute Principal stresses in members subjected to combined loading and determine the dimensions of a mechanical component subjected to static loads using theories of elastic failure.
CO2: Compute the dimensions of a component subjected to fatigue loads for finite and infinite life and calculate the dimensions of a bolted joint subjected to eccentric loading.
CO3: Design the size of a rivet and weld bead in riveted and welded joints subjected to axial and eccentric loads.
CO4: Design the diameter of a shaft supporting gears and pulleys and compute the dimensions of keys and shaft couplings subjected to torsional loading.
CO5: Design helical springs and leaf springs for static and fatigue loadings and analyze cotter joints and knuckle joint subject ted to axial loading.

UNIT – I

Introduction: General considerations in machine design, Design process, types of machine design.

Principal Stresses and Combined Loading in Machine Members:

Stresses on an oblique plane when a member subjected to combination of tensile, compressive and shear loads. Principal planes and principal stresses for general stress system. Mohr's circle construction for like stresses, unlike stresses and two perpendicular direct stresses along with simple shear. Combined Torsional and bending stresses, Various theories of elastic failure.

UNIT – II

Design against Fatigue load:

Stress concentration, Theoretical stress concentration factor, Fatigue stress concentration factor, Notch sensitivity – Design for fluctuating stresses, endurance limit, estimation of endurance strength, Goodman line, Soderberg line.

Bolted Joints: Design of bolted joints subjected toaxial loading and eccentric loading.

UNIT – III

Riveted Joints: Design of Riveted joints with axial loading on plates and under eccentric loading. Design of boiler joints, Design of longitudinal butt joint for a boiler, Design of circumferential lap joint for a boiler.

Welded Joints: Design of welded joints with axial loading on plates and eccentric loading. Strength of transverse fillet welded joints, Strength of parallel fillet welded joints, axiallyloaded unsymmetrical welded sections – Polar moment of inertia and section modulus of welds.

UNIT – IV

Shafts: Design of solid and hollow shafts for strength and rigidity, Design of shafts for combined torsion, bending and axial loads.

Keys and Shaft Couplings: Design of Sunk key, Design of couplings: Muff, Split-muff and flange couplings.

UNIT – V

Cotter and Knuckle Joints: – Design of Cotter joints: Spigot and socket, Sleeve and cotter –Knuckle joints.

Mechanical Springs: Stresses and deflections of helical springs, Extension and compression of springs – springs for fatigue loading – Energy storage capacity.

TEXT BOOKS:

1. Machine Design, V.B. Bhandari, Tata McGraw Hill Publications,
2. Machine Design, R.S. Khurmi, J.K. Gupta, S. Chand Publications,
3. Machine Design Data Book, V.B. Bhandari, Tata McGraw Hill Publications, (**Permitted for Exam).**

REFERENCESBOOKS:

1. Machine Design, Allen Strickland Hall, A. Holowenko, Herman G. Laughlin, Schaum Series, Tata McGraw Hill Publications,
2. Shigley's Machanical Engineering Design, Joseph E Shigley, Tata McGraw Hill Publications,
3. Machine Design, N.C. Pandya, C.S. Shah, Charotar Publications,
4. Machine Design, P.C.Sharma, D.K.Aggarwal,S.K.kataria& sons Publications,
5. Design of Machinery by Robert.L.Norton, McGraw-Hill Publications

AR23 – B. Tech. – ME **II Year B. Tech., II Semester**

COMPETITIVE PROGRAMMING LAB - I
(Common to ECE, EEE, MECH and CIVIL)

Subject Code: 23ESL208

COURSE OBJECTIVES:
- This course aims to enhance student proficiency in a particular programming language C++.
- Acknowledge in the value of mathematics and problem-solving techniques in programming
- Learning about the optimized solution in solving problems.

COURSE OUTCOMES: After completion of the course, the students will be able to

CO1: Use programming to find solution of the problems.
CO2: Create solution based on OOPS concept
CO3: Choose the right container to arrange data in order to solve problems.
CO4: Provide problem Solving strategies employing Recursion.
CO5: Apply mathematics to the problem Analysis. Write data retrieval queries and evaluate the result set

LAB MODULE I:
CPP Essentials: Basic Syntax, Variables, Data types, Operators, Input and output, Conditional Statements, loops.
Data Type, Conditions: https://codeforces.com/group/MWSDmqGsZm/contest/219158
Loops: https://codeforces.com/group/MWSDmqGsZm/contest/219432

LAB MODULE II:
Arrays, Functions and Strings
Arrays: https://codeforces.com/group/MWSDmqGsZm/contest/219774
Functions: https://codeforces.com/group/MWSDmqGsZm/contest/223205
Strings: https://codeforces.com/group/MWSDmqGsZm/contest/219856

LAB MODULE III:
OOPS
Class: https://www.hackerrank.com/challenges/c-tutorial-class/problem
Classes and Objects: https://www.hackerrank.com/challenges/classes-objects/problem
https://www.hackerrank.com/challenges/box-it/problem

LAB MODULE IV:
Inheritance:
https://www.hackerrank.com/domains/cpp?filters%5Bsubdomains%5D%5B%5D=inheritance
Virtual Functions:

https://www.hackerrank.com/challenges/virtual-functions/problem
Abstract Classes – Polymorphism:
https://www.hackerrank.com/challenges/abstract-classes-polymorphism/problem

LAB MODULE V:
STL - 1: Containers, Container Classes, Vectors, Lists, Iterators,set
Vector: https://www.geeksforgeeks.org/problems/c-stl-set-1-vector/1
https://www.hackerrank.com/challenges/vector-erase/problem?isFullScreen=true
Intersection of Two Arrays:
https://leetcode.com/problems/intersection-of-two-arrays/description
Set: https://www.hackerrank.com/challenges/cpp-sets/problem?isFullScreen=true
Stack:
Next Greater Element I: https://leetcode.com/problems/next-greater-element-i/description/
Valid Parentheses: https://leetcode.com/problems/valid-parentheses/description/
Largest Rectangle in Histogram:
https://leetcode.com/problems/largest-rectangle-in-histogram/description/

LAB MODULE VI:
STL -2: Maps, Bit set, Stack, Queue, De queue, Priority queue
https://www.hackerrank.com/challenges/cpp-maps/problem?isFullScreen=true
Twice counter: https://www.geeksforgeeks.org/problems/twice-counter4236/1
Frequency Game: https://www.geeksforgeeks.org/problems/frequency-game/1
Check if a string is repetition of its substring of k-length: https://www.geeksforgeeks.org/problems/check-if-a-string-is-repetition-of-its-substring-of-k-length3302/1
Dequeue: https://www.hackerrank.com/challenges/deque-stl/problem?isFullScreen=true

LAB MODULE VII:
Problem solving approaches : precomputation, Two pointer
Two Sum II : https://leetcode.com/problems/two-sum-ii-input-array-is-sorted/description/
Rotate Array: https://leetcode.com/problems/rotate-array/description/
Container With Most Water: https://leetcode.com/problems/container-with-most-water/description/
Remove Duplicates from Sorted Array:
https://leetcode.com/problems/remove-duplicates-from-sorted-array/description/
Product of Array Except Self:
https://leetcode.com/problems/product-of-array-except-self/description/
Reverse Words in a String II:
https://leetcode.com/problems/reverse-words-in-a-string-ii/description/

LAB MODULE VIII:
Problem solving approaches:
Sliding Window approach, fixed window approach and varying window approaches
Max Consecutive Ones I:
https://leetcode.com/problems/max-consecutive-ones/description/
Max Consecutive Ones II:
https://leetcode.com/problems/max-consecutive-ones-ii/description/

Longest Substring with At Most Two Distinct Characters:
https://leetcode.com/problems/longest-substring-with-at-most-two-distinct-characters/description/
Longest Substring Without Repeating Characters:
https://leetcode.com/problems/longest-substring-without-repeating-characters/description/
Find All Anagrams in a String:
https://leetcode.com/problems/find-all-anagrams-in-a-string/description/
SQL Part1:
SQL Command, Data Types, Operators and Expressions, DDL statements, DML statements, Functions, Sorting Data, Grouping Data

Practice problems: -
https://www.hackerrank.com/domains/sql?filters%5Bsubdomains%5D%5B%5D=select
https://www.hackerrank.com/domains/sql?filters%5Bsubdomains%5D%5B%5D=aggregation
https://www.sqlzoo.net/wiki/SQL_Tutorial
SQL Part2: Cartesian Product and Inner Join, Self Join, Outer Join, Subquery, Independent Subquery, Correlated Subquery

Practice problems: -
https://www.hackerrank.com/domains/sql?filters%5Bsubdomains%5D%5B%5D=join
https://www.hackerrank.com/domains/sql?filters%5Bsubdomains%5D%5B%5D=advanced-join
https://www.sqlzoo.net/wiki/SQL_Tutorial

Text Books:

1. The Complete Reference C++ by Herbert Schildt ,4th Edition

2. E. Horowitz. et.al., Fundamentals of computer Algorithms, Universities Press, 2008, 2nd Edition.

Reference Books:

1. Competitive Programming 3: The New Lower Bound of Programming Contests Book by Felix Halim and Steven Halim, 423 pages

2. Programming Pearls Book by Jon Bentley, 258 pages.T.H. Cormen et.al. – Introduction to Algorithms – PHI, New Delhi, 2005

3. S.Dasgupta et.al. – Algorithms, TMH, New Delhi – 2007.

4. SQL Quickstart Guide: The Simplified Beginner's Guide to SQL by Clydebank Technology

Resources:
1. https://leetcode.com/problems/
2. https://nptel.ac.in/courses/106106145/
3. https://www.spoj.com/problem

AR23 – B. Tech. – ME **II Year B. Tech., II Semester**

HEAT TRANSFER LAB

Subject Code: 23MEL203

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:
The course content enables students to:

- To understand the basic concepts of conduction heat transfer in different coordinate systems and apply it to estimate the thermal property of materials of different shapes.
- To understand the basic concepts of conduction heat transfer in steady state and apply it to estimate the efficiency of pin-fin.
- To understand the basic concepts of convection heat transfer and apply it to estimate the thermal property of fluids undergoing free and forced convection.
- To understand the basic concepts of condensation and apply it to estimate the rate of heat transfer due to drop wise and film wise condensation.
- To understand the basic concepts of heat exchanger and apply it to estimate the effectiveness of different types of heat exchangers.
- To understand the basic concepts of radiation and apply it to estimate the emissivity of a material.

COURSEOUTCOMES: On completion of this course, students should be able to

CO1. Evaluate heat transfer through composite systems and estimate the resistivity and conductivity of insulating materials and metal rod respectively.
CO2. Evaluate the heat transfer coefficient for fluids undergoing forced convection and natural convection.
CO3. Evaluate the efficiency of pin-fin undergoing both free and forced convection.
CO4. Evaluate heat effectiveness of a double-pipe heat exchanger undergoing parallel-flow and counter-flow and that of a shell and tube heat exchanger.
CO5. Evaluate Stefan-Boltzman constant and emissivityof a given material. Calculate the rate of heat transfer due to drop wise and film wise condensation

List of Experiments

1. Composite Slab Apparatus–Overall heat transfer co-efficient.
2. Heat transfer through lagged pipe. Estimation of resistivity of materials.

3. Heat Transfer through a Concentric Sphere. Estimation of resistivity of insulating powder.
4. Determination of thermal conductivity of metal rod.
5. Determination of temperature distribution, efficiency and effectiveness of a pin-fin used in free and forced convection environment.
6. Determination of transient thermal history of a metal
7. Determination of heat transfer coefficient in forced convection apparatus.
8. Determination of heat transfer coefficient in free convection apparatus.
9. Determination of LMTD and effectiveness of Parallel and Counter flow heat exchanger (concentric tube heat exchanger).
10. Determination of emissivity of specimen (emissivity apparatus)
11. To verify the Stefen-Boltzmann constant for thermal radiation.
12. Heat transfer in drop and film wise condensation.
13. Demonstration of finding critical thickness of insulation of a material
14. Determination of effectiveness of Shell and Tube heat exchanger

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DESIGN AND PRODUCTION TECHNOLOGY LAB

Subject Code: 23MEL204

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

- To understand the basic concepts of 2D drafting
- To gain knowledge of drawing basic machine elements
- Practically understand different manufacturing processes in production technology.
- Practically understand the difference between cold working and hot working processes.

COURSE OUTCOMES: On completion of this course, students should be able to

CO 1. Preparation of engineering and working drawings with dimensions using 2D CAD software

CO 2. Construct machine elements such as screws, nuts, bolts, keys, riveted joints and couplings using 2D CAD software

CO 3. Prepare green sand mold for single-piece and split-piece patterns.

CO 4. Create joints using electric arc, spot, gas welding techniques.

CO 5. Produce components using injection molding and mechanical press machines.

LIST OF EXPERIMENTS:

Part A: Drawing of simple partsand machine elements (using any drafting software)

1. Create simple line drawings using editing commands, constraints, and dimensioning.
2. Popular forms of Screw threads, bolts, nuts, stud bolts, tap bolts, set screws.
3. Keys, cottered joints and knuckle joint.
4. Rivetted joints for plates
5. Shaft coupling, spigot and socket pipe joint.

Part B:

I. MOLDING PRACTICE:

1. Preparation of a green sand mould using single piece pattern.
2. Preparation of a green sand mould using split piece pattern.

II. WELDING PRACTICE:

3. Preparation of a butt joint using electric arc welding.
4. Preparation of a lap joint using arc welding.
5. Preparation of a lap joint using spot welding.

III. PLASTIC MOLDING:

Injection Molding:

6. Preparation of a key chain by using two plate mold**.**
7. Preparation of a bottle cap by using three plate mold**.**

Mechanical Presses:

8. Preparation of a pipe bends using hydraulic press.
9. Preparation of a washer using mechanical press.

NOTE:

1. First angle projection to be adopted. The student should be able to provide working drawings of actual parts.
2. Part A need to be done by using AUTOCAD

TEXT BOOKS:

1. Machine Drawing –K.L.Narayana, P. Kannaiah & K.Venkata Reddy / New Age/ Publishers
2. Machine Drawing with Auto CAD / Goutham Pohit, Goutam Ghosh / Pearson
3. Machine Drawing / N.D. Bhatt / Charotar

REFERENCE BOOKS:

1. Machine Drawing by / Bhattacharyya / Oxford
2. Machine Drawing / Ajeet Singh / Mc Graw Hill
3. Machine Drawing –P.S.Gill.

AR23 – B. Tech. – ME **II Year B. Tech., II Semester**

DESIGN THINKING

(Common to All Branches)

Subject Code: 23BHT208

L	T	P	C
1	0	2	2

COURSE OBJECTIVES:

- Understand the significance of Design Thinking in engineering disciplines and develop empathy-building skills.
- Explore various ideation techniques to generate innovative design solutions.
- Learn to incorporate user feedback into design iterations for continuous improvement.
- Apply Design Thinking principles to real-world engineering problems.
- Collaborate in teams to solve complex engineering problems using Design Thinking principles.

COURSE OUTCOMES:

CO1: Students will be able to explain the importance of Design Thinking in engineering contexts and use empathy-building techniques

CO2: Students will be able to generate a diverse range of design ideas using creative ideation techniques.

CO3: Students will demonstrate the ability to iteratively refine design solutions based on user feedback.

CO4: Students will be able to apply Design Thinking methodologies to solve engineering challenges effectively.

CO5: Students will effectively collaborate in teams to develop innovative solutions to engineering challenges during workshop activities.

Unit I: Introduction to Design Thinking

Entrepreneurship Challenges and prospects, Design Thinking- definition and Importance, Core principles of Design Thinking, Techniques for empathy building, User research methods,

Unit II: Ideate and Prototype

Creative ideation techniques (Brainstorming, Mind Mapping, SCAMPER, etc.), Prototyping fundamentals and materials, Rapid Prototyping Methods, Iterative Design Processes

Unit III: Test and Iterate

User testing principles and methodologies, Iterative design cycles, Evaluation criteria for design solutions

Unit IV: Design Thinking in Engineering Applications

Case studies of Design Thinking in engineering projects, Applying Design Thinking to product design, process improvement, and problem-solving, Challenges and opportunities in integrating Design Thinking into engineering practice

Unit V: Workshop: Application of Design Thinking

Hands-on workshop sessions to practice empathy building, ideation, prototyping, and iteration, Presentation of workshop outcomes and reflections on the Design Thinking process

Reference

- Lockwood, T. (2010). *Design Thinking: Integrating Innovation, Customer Experience, and Brand Value*. Allworth Press.
- Brown, T. (2009). *Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation*. HarperBusiness.
- Norman, D. (2013). *The Design of Everyday Things* (Revised and Expanded Edition). Basic Books.
- Knapp, J., Zeratsky, J., &Kowitz, B. (2016). *Sprint: How to Solve Big Problems and Test New Ideas in Just Five Days*. Simon & Schuster.
- Cross, B. (2018). *Design Thinking for Engineers and Technologists.* Wiley.
- Kumar, V. (2012). 101 *Design Methods: A Structured Approach for Driving Innovation in Your Organization.* Wiley.
- Kelley, T., & Kelley, D. (2013). *Creative Confidence: Unleashing the Creative Potential Within Us All.* Crown Business.
- Mootee, I. (2013). *Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School*. Wiley.
- Ries, E. (2011). *The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses*. Crown Business.
- Polaine, A., Løvlie, L., & Reason, B. (2013). *Service Design: From Insight to Implementation.* Rosenfeld Media.