LAKIREDDY BALI REDDY COLLEGE OF ENGINEERING
(AUTONOMOUS)
Mylavaram-521 230, Krishna Dist., Andhra Pradesh

B. Tech (Regular-Full time)

(Effective for the students admitted into I year from the AcademicYear **2023-24** onwards)

&

B.Tech.(Lateral Entry Scheme)

(Effective for the students admitted into II year through Lateral Entry Scheme from the Academic Year **2024 - 25** onwards)

B.TECH. – MECHANICAL ENGINEERING COURSE STRUCTURE – R23
(Applicable from the academic year 2023-24 onwards)

I Semester

S. No.	Course Code	Course Title	Contact hours/week			Credits	Scheme of Valuation		
			L	T	P		CIE	SEE	Total
Theory Courses									
1	23FE01	Communicative English	2	0	0	2	30	70	100
2	23FE03	Linear Algebra & Calculus	3	0	0	3	30	70	100
3	23FE04	Engineering Physics	3	0	0	3	30	70	100
4	23CM01	Basic Civil And Mechanical Engineering	3	0	0	3	30	70	100
5	23ME01	Engineering Graphics	2	0	2	3	30	70	100
Laboratory Courses									
6	23FE51	Communicative English Lab	0	0	2	1	30	70	100
7	23FE53	Engineering Physics Lab	0	0	2	1	30	70	100
8	23IT51	IT Workshop	0	0	2	1	30	70	100
9	23ME51	Engineering Workshop	0	0	3	1.5	30	70	100
10	23AU02	NSS/NCC/Scouts & Guides/Community Service	0	0	1	0.5	100	--	100
Total			**13**	**0**	**12**	**19**	**370**	**630**	**1000**

II Semester

S. No.	Course Code	Course Title	Contact hours/week			Credits	Scheme of Valuation		
			L	T	P		CIE	SEE	Total
Theory Courses									
1	23FE05	Differential Equations & Vector Calculus	3	0	0	3	30	70	100
2	23FE06	Engineering Chemistry	3	0	0	3	30	70	100
3	23EE01	Basic Electrical & Electronics Engineering	3	0	0	3	30	70	100
4	23CS01	Introduction to Programming	3	0	0	3	30	70	100
5	23ME02	Engineering Mechanics	3	0	0	3	30	70	100
Laboratory Courses									
6	23FE54	Engineering Chemistry Lab	0	0	2	1	30	70	100
7	23EE51	Electrical & Electronics Engineering Workshop	0	0	3	1.5	30	70	100
8	23CS51	Computer Programming Lab	0	0	3	1.5	30	70	100
9	23ME52	Engineering Mechanics Lab	0	0	3	1.5	30	70	100
10	23AU01	Health and wellness, Yoga and sports	0	0	1	0.5	100	--	100
Total			**15**	**0**	**12**	**21**	**370**	**630**	**1000**

III Semester

S. No.	Course Code	Course Title	Contact hours/week			Credits	Scheme of Valuation		
			L	T	P		CIE	SEE	Total
Theory Courses									
1	23FE09	Numerical Methods and TransformTechniques	3	0	0	3	30	70	100
2	23ME03	Thermodynamics	2	0	0	2	30	70	100
3	23ME04	Mechanics of Solids	3	0	0	3	30	70	100
4	23ME05	Material Science and Metallurgy	3	0	0	3	30	70	100
5	23HS01	UHV 2 – understanding harmony and Ethical human conduct	2	1	0	3	30	70	100
6	23MC01	Environmental Science	2	0	0	-	30	--	30
Laboratory Courses									
7	23ME53	Mechanics of Solids and Materials Science Lab	0	0	3	1.5	30	70	100
8	23ME54	Computer-aided Machine Drawing	0	0	3	1.5	30	70	100
9	23CS57	Python programming Lab	0	0	2	1.0	30	70	100
10	23ECS1	Embedded Systems and IoT	0	1	2	2	30	70	100
Total			**15**	**2**	**10**	**20**	**300**	**630**	**930**

IV Semester

S. No.	Course Code	Course Title	Contact hours/week			Credits	Scheme of Valuation		
			L	T	P		CIE	SEE	Total
Theory Courses									
1	23FE13	Complex Variables, Probability and Statistics	3	0	0	3	30	70	100
2	23ME06	Manufacturing processes	3	0	0	3	30	70	100
3	23ME07	Fluid Mechanics & Hydraulic Machines	3	0	0	3	30	70	100
4	23ME08	Theory of Machines	3	0	0	3	30	70	100
5	23HS03	Industrial Management	2	0	0	2	30	70	100
Laboratory Courses									
6	23ME55	Fluid Mechanics & Hydraulic Machines Lab	0	0	3	1.5	30	70	100
7	23ME56	Manufacturing processes Lab	0	0	3	1.5	30	70	100
8	23ME57	Design Thinking & Innovation	1	0	2	2	30	70	100
9	23MES1	Structural and Modal Analysis Using ANSYS	0	1	2	2	30	70	100
Total			**15**	**1**	**10**	**21**	**270**	**630**	**900**
Mandatory Community Service Project Internship of 08 weeks duration during summer Vacation									

V Semester

S. No.	Course Code	Course Title	Contact hours/week			Credits	Scheme of Valuation		
			L	T	P		CIE	SEE	Total
Theory Courses									
1	23ME10	Machine Tools and Metrology	3	0	0	3	30	70	100
2	23ME11	Thermal Engineering	3	0	0	3	30	70	100
3	23ME12	Design of Machine Elements	3	0	0	3	30	70	100
PROGRAM ELECTIVE – I									
4	23ME13	Design for Manufacturing	3	0	0	3	30	70	100
	23ME14	Conventional and Futuristic Vehicle Technology	3	0	0	3	30	70	100
	23ME15	Micro Electro Mechanical Systems	3	0	0	3	30	70	100
	23ME16	Industrial Robotics	3	0	0	3	30	70	100
5	OE-I	Open Elective – I	3	0	0	3	30	70	100
Laboratory Courses									
6	23ME58	Thermal Engineering Lab	0	0	3	1.5	30	70	100
7	23ME59	Theory of Machines Lab	0	0	3	1.5	30	70	100
8	23MES2	Machine Tools and Metrology Lab	0	0	4	2	30	70	100
9	23EM01	Tinkering Lab	0	0	2	1	30	70	100
10	23PI01	Evaluation of Community Service Internship	-	-	-	2	-	50	50
Total			**15**	**0**	**12**	**23**	**270**	**680**	**950**

VI Semester

S. No.	Course Code	Course Title	Contact hours/week			Credits	Scheme of Valuation		
			L	T	P		CIE	SEE	Total
Theory Courses									
1	23ME17	Heat Transfer	3	0	0	3	30	70	100
2	23ME18	Artificial Intelligence and Machine Learning	3	0	0	3	30	70	100
3	23ME19	Finite Element Methods	3	0	0	3	30	70	100
PROGRAM ELECTIVE – II									
4	23ME20	Mechanical Vibrations	3	0	0	3	30	70	100
	23ME21	Advanced Manufacturing Processes	3	0	0	3	30	70	100
	23ME22	Renewable Energy Technologies	3	0	0	3	30	70	100
	23ME23	Sensors and Instrumentation	3	0	0	3	30	70	100
PROGRAM ELECTIVE – III									
5	23ME24	Energy Storage Technologies	3	0	0	3	30	70	100
	23ME25	Industrial Hydraulics and Pneumatics	3	0	0	3	30	70	100
	23ME26	Non -Destructive Evaluation	3	0	0	3	30	70	100
	23ME27	Refrigeration and Air Conditioning	3	0	0	3	30	70	100
6	OE-II	Open Elective-II	3	0	0	3	30	70	100
Laboratory Courses									
7	23ME60	Heat Transfer Lab	0	0	3	1.5	30	70	100
8	23ME61	Artificial Intelligence and Machine Learning Lab	0	0	3	1.5	30	70	100
9	23MES3	Robotics and Drone Technologies Lab	0	0	4	2	30	70	100
10	23MC04	Technical Paper Writing and IPR	2	0	0	-	30	-	30
Total			**20**	**1**	**8**	**23**	**300**	**630**	**930**
Mandatory Industry Internship of 08 weeks duration during summer vacation									

LAKIREDDY BALI REDDY COLLEGE OF ENGINEERING (AUTONOMOUS)

OPEN ELECTIVES

Course Code	Course Name	Offered to the branches
23AD81	Introduction to Artificial Intelligence	ASE, CE, ECE,EEE & ME
23AD82	Fundamentals of Data Science	ASE, CE, ECE,EEE & ME
23AD83	Introduction to Cloud Computing	ASE, CE, ECE,EEE & ME
23AD84	Data Analytics	ASE, CE, ECE,EEE & ME
23AE81	PRINCIPLES OF FLIGHT	AI&DS, CE,CSE, CSE(AI&ML), ECE,EEE,IT & ME
23AE82	SPACE SCIENCE	AI&DS, CE,CSE, CSE(AI&ML), ECE,EEE,IT & ME
23AE83	AIRCRAFT INSTRUMENTATION	AI&DS, CE,CSE, CSE(AI&ML), ECE,EEE,IT & ME
23AE84	AIR TRANSPORTATION SYSTEMS	AI&DS, CE,CSE, CSE(AI&ML), ECE,EEE,IT & ME
23AM81	Python Programming for AI & ML	ASE, CE, ECE,EEE & ME
23AM82	AI in healthcare	ASE, CE, ECE,EEE & ME
23AM83	Fundamentals of Machine Learning	ASE, CE, ECE,EEE & ME
23AM84	Introduction to Deep learning	ASE, CE, ECE,EEE & ME
23CE81	Disaster Management	ASE,AI&DS,CSE, CSE(AI&ML), ECE,EEE,IT & ME
23CE82	Climate change impact on Eco system	ASE,AI&DS,CSE, CSE(AI&ML), ECE,EEE,IT & ME
23CE83	Environmental Sanitation	ASE,AI&DS,CSE, CSE(AI&ML), ECE,EEE,IT & ME
23CE84	Introduction to Remote Sensing and GIS	ASE,AI&DS,CSE, CSE(AI&ML), ECE,EEE,IT & ME
23CE85	Water Supply Systems	ASE,AI&DS,CSE, CSE(AI&ML), ECE,EEE,IT & ME
23CE86	Sustainability in Engineering Practices	ASE,AI&DS,CSE, CSE(AI&ML), ECE,EEE,IT & ME
23CS81	Introduction to Java Programming	ASE, CE, ECE,EEE & ME
23CS82	Principles of Operating Systems	ASE, CE, ECE,EEE & ME
23CS83	Principles of Database Management Systems	ASE, CE, ECE,EEE & ME
23CS83	Principles of Database Management Systems	ASE, CE, ECE,EEE & ME
23CS84	IoT based smart Systems	ASE, CE, ECE,EEE & ME
23EC81	Linear and Digital IC Applications	ASE,AI&DS, CE,CSE, CSE(AI&ML), EEE,IT & ME
23EC82	Principles of communications	ASE,AI&DS, CE,CSE, CSE(AI&ML), EEE,IT & ME
23EC83	Fundamentals of VLSI Design	ASE,AI&DS, CE,CSE, CSE(AI&ML), EEE,IT & ME
23EC84	Principles of Cellular & Mobile communications	ASE,AI&DS, CE,CSE, CSE(AI&ML), EEE,IT & ME
23EC85	Fundamentals of Satellite Communications	ASE,AI&DS, CE,CSE, CSE(AI&ML), EEE,IT & ME

LAKIREDDY BALI REDDY COLLEGE OF ENGINEERING (AUTONOMOUS)

Course Code	Course Name	Offered to the branches
23EE81	Basic Control System	ASE,AI&DS, CE,CSE, CSE(AI&ML), ECE,IT & ME
23EE82	Basic Electrical Measurements	ASE,AI&DS, CE,CSE, CSE(AI&ML), ECE,IT & ME
23EE83	Utilization of Electrical Energy	ASE,AI&DS, CE,CSE, CSE(AI&ML), ECE,IT & ME
23EE84	Electric Vehicles	ASE,AI&DS, CE,CSE, CSE(AI&ML), ECE,IT & ME
23EE85	Concepts of Energy Auditing & Management	ASE,AI&DS, CE,CSE, CSE(AI&ML), ECE,IT & ME
23EE86	Electrical Wiring Estimation and Costing	ASE,AI&DS, CE,CSE, CSE(AI&ML), ECE,IT & ME
23IT81	Computer System Architecture	ASE, CE, ECE,EEE & ME
23IT82	Introduction to Programming in Java	ASE, CE, ECE,EEE & ME
23IT83	Principles of Software Engineering	ASE, CE, ECE,EEE & ME
23ME81	Sustainable Energy Technologies	ASE,AI&DS, CE,CSE, CSE(AI&ML), ECE,EEE & IT
23ME82	Introduction to Industrial Robotics	ASE,AI&DS, CE,CSE, CSE(AI&ML), ECE,EEE & IT
23ME83	Applied Operations Research	ASE,AI&DS, CE,CSE, CSE(AI&ML), ECE,EEE & IT
23ME84	Entrepreneurship	ASE,AI&DS, CE,CSE, CSE(AI&ML), ECE,EEE & IT
23ME85	Additive Manufacturing	ASE,AI&DS, CE,CSE, CSE(AI&ML), ECE,EEE & IT
23ME86	Vehicle Technology	ASE,AI&DS, CE,CSE, CSE(AI&ML), ECE,EEE & IT

B.Tech. (I Sem.)

23FE01-COMMUNICATIVE ENGLISH

(Common to All Branches of Engineering)

L	T	P	C
2	0	0	2

Course Objectives:

The main objective of introducing this course, *Communicative English,* is to facilitate effective listening, Reading, Speaking and Writing skills among the students. It enhances the same in their comprehending abilities, oral presentations, reporting useful information and providing knowledge of grammatical structures and vocabulary. This course helps the students to make them effective in speaking and writing skills and to make them industry ready.

Course Outcomes:

CO1	Understand the context, topic, and pieces of specific information from social or Transactional dialogues.	**Understand**
CO2	Apply grammatical structures to formulate sentences and correct word forms.	**Apply**
CO3	Use discourse markers to speak clearly on a specific topic in informal discussions.	**Apply**
CO4	Read / Listen the texts and write summaries based on global comprehension of these texts.	**Understand**
CO5	Prepare a coherent paragraph, essay, and resume.	**Apply**

UNIT I

Lesson: HUMAN VALUES: Gift of Magi **(Short Story)**

Listening: Identifying the topic, the context and specific pieces of information by listening to short audio texts and answering a series of questions.

Speaking: Asking and answering general questions on familiar topics such as home, family, work, studies and interests; introducing oneself and others.

Reading: Skimming to get the main idea of a text; scanning to look for specific pieces of information.

Writing: Mechanics of Writing-Capitalization, Spellings, Punctuation-Parts of Sentences.

Grammar: Parts of Speech, Basic Sentence Structures-forming questions

Vocabulary: Synonyms, Antonyms, Affixes (Prefixes/Suffixes), Root words.

UNIT II

Lesson: NATURE: The Brook by Alfred Tennyson (Poem)

Listening: Answering a series of questions about main ideas and supporting ideas afterlistening to audio texts.

Speaking: Discussion in pairs/small groups on specific topics followed by short structuretalks.

Reading: Identifying sequence of ideas; recognizing verbal techniques that help to linkthe ideas in a paragraph together.

Writing: Structure of a paragraph - Paragraph writing (specific topics)

Grammar: Cohesive devices - linkers, use of articles and zero article; prepositions.

Vocabulary: Homonyms, Homophones, Homographs.

UNIT III

Lesson: BIOGRAPHY: Elon Musk

Listening: Listening for global comprehension and summarizing what is listened to.

Speaking: Discussing specific topics in pairs or small groups and reporting what isdiscussed

Reading: Reading a text in detail by making basic inferences -recognizing and interpretingspecific context clues; strategies to use text clues for comprehension.

Writing: Summarizing, Note-making, paraphrasing

Grammar: Verbs - tenses; subject-verb agreement; Compound words, Collocations

Vocabulary: Compound words, Collocations

UNIT IV

Lesson: INSPIRATION: The Toys of Peace by Saki

Listening: Making predictions while listening to conversations/ transactional dialogues without video; listening with video.

Speaking: Role plays for practice of conversational English in academic contexts (formal and informal) - asking for and giving information/directions.

Reading: Studying the use of graphic elements in texts to convey information, reveal trends/patterns/relationships, communicate processes or display complicated data.

Writing: Letter Writing: Official Letters, Resumes

Grammar: Reporting verbs, Direct & Indirect speech, Active & Passive Voice

Vocabulary: Words often confused, Jargons

UNIT V

Lesson: MOTIVATION: The Power of Intrapersonal Communication (An Essay)

Listening: Identifying key terms, understanding concepts and answering a series of relevant questions that test comprehension.

Speaking: Formal oral presentations on topics from academic contexts

Reading: Reading comprehension.

Writing: Writing structured essays on specific topics.

Grammar: Editing short texts –identifying and correcting common errors in grammar andusage (articles, prepositions, tenses, subject verb agreement)

Vocabulary: Technical Jargons

Textbooks:

1. Pathfinder: Communicative English for Undergraduate Students, 1st Edition, OrientBlack Swan, 2023 (Units 1,2 & 3)
2. Empowering with Language 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 UniversityPress, 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

B.Tech. (I Sem.)

23FE03- LINEAR ALGEBRA & CALCULUS

(Common to All Branches of Engineering)

L	T	P	C
3	0	0	3

Course Objectives:

To equip the students with standard concepts and tools at an intermediate to advanced level mathematics to develop the confidence and ability among the students to handle various real-world problems and their applications.

Course Outcomes: At the end of the course, the student will be able to

CO1	Apply matrix algebra techniques to solve engineering problems.	**Apply**
CO2	Use Eigen values and Eigen vectors concept to find nature of quadratic form, inverse and powers of matrix.	**Apply**
CO3	Expand various functions using Mean value theorems.	**Understand**
CO4	Understand the concepts of functions of several variables which are useful in optimization.	**Understand**
CO5	Evaluate areas and volumes by using double and triple integrals.	**Apply**

UNIT I Matrices

Rank of a matrix by echelon form, normal form. Cauchy–Binet formulae (without proof). 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, Jacobi and Gauss Seidel Iteration Methods.

UNIT II Eigenvalues, Eigenvectors and Orthogonal Transformation

Eigenvalues, Eigenvectors and their properties, 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 Quadratic form to canonicalforms 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) Functions of several variables: Continuity and Differentiability, Partial derivatives, total derivatives, chain rule, Directional derivative, Taylor's and Maclaurin's series expansion of functions of two variables. Jacobians, Functional dependence, maxima and minima of functions of two variables, method of Lagrange multipliers.

UNIT V Multiple Integrals (Multi variable Calculus)

Double integrals, triple integrals, change of order of integration, change of variables to polar, cylindrical and spherical coordinates. Finding areas (by double integrals) and volumes (by double integrals and triple integrals).

Textbooks:

1. Higher Engineering Mathematics, B. S. Grewal, Khanna Publishers, 2017, 44th Edition
2. Advanced Engineering Mathematics, Erwin Kreyszig, John Wiley & Sons, 2018, 10th Edition.

Reference Books:

1. Thomas Calculus, George B. Thomas, Maurice D. Weir and Joel Hass, PearsonPublishers, 2018, 14th Edition.
2. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Alpha ScienceInternational Ltd., 2021 5th Edition(9th reprint).
3. Advanced Modern Engineering Mathematics, Glyn James, Pearson publishers, 2018, 5th Edition.
4. Advanced Engineering Mathematics, Micheael Greenberg, , Pearson publishers, 9th edition
5. Higher Engineering Mathematics, H. K Das, Er. Rajnish Verma, S. Chand Publications,2014, Third Edition (Reprint 2021)

B.Tech. (I Sem.)

23FE04- ENGINEERING PHYSICS

(Common to All Branches of Engineering)

L	T	P	C
3	0	0	3

Course Objectives:

To bridge the gap between the Physics in school at 10+2 level and UG level engineering coursesby identifying the importance of the optical phenomenon like interference, diffraction etc, enlightening the periodic arrangement of atoms in crystalline solids and concepts of quantum mechanics, introduce novel concepts of dielectric and magnetic materials, physics of semiconductors.

Course Outcomes:

CO1: Analyze the intensity variation of light due to interference, diffraction, and Polarization (**Apply**).

CO2: Understand the basics of crystals and their structures (**Understand**).

CO3: Summarize various types of polarization of dielectrics and classify the magnetic materials (**Understand**)

CO4: Explain fundamentals of quantum mechanics and free electron theory of metals (**Understand**).

CO5: Identify the type of semiconductor using Hall Effect (**Apply**).

UNIT I Wave Optics

Interference: Introduction - Principle of superposition –Interference of light - Interference in thin films (Reflection Geometry) & applications - Colours 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 & N-slits (Qualitative) – Diffraction Grating - Dispersive power and resolving power of Grating (Qualitative). Polarization: Introduction -Types of polarization - Polarization by reflection, refraction and Double refraction - Nicol's Prism -Half wave and Quarter wave plates.

UNIT II Crystallography and X-ray diffraction

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.

X-ray diffraction: Bragg's law - X-ray Diffractometer – crystal structure determination by Laue's and powder methods

UNIT III Dielectric and Magnetic Materials

Dielectric Materials: Introduction - Dielectric polarization - Dielectric polarizability, Susceptibility, Dielectric constant and Displacement Vector – Relation between the electric vectors - Types of polarizations- Electronic (Quantitative), Ionic (Quantitative) and Orientation polarizations (Qualitative) - Lorentz internal field - Clausius- Mossotti equation - complex dielectric constant – Frequency dependence of polarization – dielectric loss

Magnetic Materials: Introduction - Magnetic dipole moment - Magnetization-Magnetic susceptibility and permeability – Atomic origin of magnetism - Classification of magnetic materials: Dia, para, Ferro, anti-ferro & Ferri magnetic materials - Domain concept for

Ferromagnetism & Domain walls (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 dependentwave 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 - Density of states - Fermi energy

UNIT V Semiconductors

Semiconductors: Formation of energy bands – classification of crystalline solids - Intrinsic semiconductors: Density of charge carriers – Electrical conductivity – Fermi level – Extrinsic semiconductors: density of charge carriers – dependence of Fermi energy on carrier concentration and temperature - Drift and diffusion currents – Einstein's equation – Hall effectand its applications.

Textbooks:

1. A Text book of Engineering Physics, M. N. Avadhanulu, P.G.Kshirsagar & TVS Arun Murthy, S. Chand Publications, 11th Edition 2019.
2. Engineering Physics - D.K.Bhattacharya and Poonam Tandon, Oxford press (2015)

Reference Books:

1. Engineering Physics - B.K. Pandey and S. Chaturvedi, Cengage Learning 2021.
2. Engineering Physics - Shatendra Sharma, Jyotsna Sharma, Pearson Education, 2018.
3. Engineering Physics" - Sanjay D. Jain, D. Sahasrabudhe and Girish, University Press.2010
4. Engineering Physics - M.R. Srinivasan, New Age international publishers (2009).

Web Resources: https://www.loc.gov/rr/scitech/selected-internet/physics.html

L	T	P	C
3	0	0	3

B.Tech. (I Sem.)

23CM01- BASIC CIVIL AND MECHANICAL ENGINEERING

(Common to All Branches of Engineering)

PART A: BASIC CIVIL ENGINEERING

Course Objectives:

- Get familiarized with the scope and importance of Civil Engineering sub-divisions.
- Introduce the preliminary concepts of surveying.
- Acquire preliminary knowledge on Transportation and its importance in nation'seconomy.
- Get familiarized with the importance of quality, conveyance and storage of water.
- Introduction to basic civil engineering materials and construction techniques.

Course Outcomes: On completion of the course, the student should be able to:

CO1: Describe various sub-divisions of Civil Engineering and to appreciate their role in societal development. **(Understand)**

CO2: Outline the concepts of surveying and obtain the theoretical measurement of distances, angles and levels through surveying. **(Understand)**

CO3: Classify the various materials used in construction and highway engineering and identify their appropriate usage as per the needs. **(Understand)**

CO4: Illustrate the fundamental principles involved in transportation network system, their individual components and their engineering importance. **(Understand)**

CO5: Explain the quality parameters of various water sources and functions of selected water storage and conveyance structures. **(Understand)**

UNIT I

Basics of Civil Engineering: Role of Civil Engineers in Society- Various Disciplines of Civil Engineering- Structural Engineering- Geo-technical Engineering- Transportation Engineering- Hydraulics and Water Resources Engineering - Environmental Engineering-Scope of each discipline - Building Construction and Planning- Construction Materials-Cement - Aggregate - Bricks- Cement concrete- Steel. Introduction to Prefabricated construction Techniques.

UNIT II

Surveying: Objectives of Surveying- Horizontal Measurements- Angular Measurements- Introduction to Bearings Levelling instruments used for levelling -Simple problems on levellingand bearings-Contour mapping.

UNIT III

Transportation Engineering Importance of Transportation in Nation's economic development- Types of Highway Pavements- Flexible Pavements and Rigid Pavements - Simple Differences. Basics of Harbour, Tunnel, Airport, and Railway Engineering.

Water Resources and Environmental Engineering: Introduction, Sources of water- Quality of water- Specifications- Introduction to Hydrology–Rainwater Harvesting-Water Storage and

Conveyance Structures (Simple introduction to Dams and Reservoirs).

Textbooks:

1. Basic Civil Engineering, M.S.Palanisamy, , Tata Mcgraw Hill publications (India) Pvt. Ltd. Fourth Edition.
2. Introduction to Civil Engineering, S.S. Bhavikatti, New Age International Publishers.2022. First Edition.
3. Basic Civil Engineering, Satheesh Gopi, Pearson Publications, 2009, First Edition.

Reference Books:

1. Surveying, Vol- I and Vol-II, S.K. Duggal, Tata McGraw Hill Publishers 2019. Fifth Edition.
2. Hydrology and Water Resources Engineering, Santosh Kumar Garg, Khanna Publishers, Delhi. 2016
3. Irrigation Engineering and Hydraulic Structures - Santosh Kumar Garg, KhannaPublishers, Delhi 2023. 38th Edition.
4. Highway Engineering, S.K.Khanna, C.E.G. Justo and Veeraraghavan, Nemchand and Brothers Publications 2019. 10th Edition.
5. Indian Standard DRINKING WATER — SPECIFICATION IS 10500-2012.

PART B: BASIC MECHANICAL ENGINEERING

Course Objectives: The students after completing the course are expected to

- Get familiarized with the scope and importance of Mechanical Engineering in different sectors and industries.
- Explain different engineering materials and different manufacturing processes.
- Provide an overview of different thermal and mechanical transmission systems and introduce basics of robotics and its applications.

Course Outcomes: On completion of the course, the student should be able to

CO1: Summarize the different manufacturing processes. (**Remember**)

CO2: Explain the basics of thermal engineering and its applications. (**Understand**)

CO3: Illustrate the working of different mechanical power transmission systems and power plants.(**Understand**)

CO4: Describe the basics of robotics and its applications. (**Understand**)

UNIT I

Introduction to Mechanical Engineering: Role of Mechanical Engineering in Industries and Society- Technologies in different sectors such as Energy, Manufacturing, Automotive, Aerospace, and Marine sectors.

Engineering Materials - Metals-Ferrous and Non-ferrous, Ceramics, Composites, Smart materials.

UNIT II

Manufacturing Processes: Principles of Casting**,** Forming, joining processes, Machining, Introduction to CNC machines, 3D printing, and Smart manufacturing.

Thermal Engineering – Working principle of Boilers, Otto cycle, Diesel cycle, Refrigeration and air-conditioning cycles, IC engines, 2-Stroke and 4-Stroke engines, SI/CI Engines, Components of Electric and Hybrid Vehicles.

UNIT III

Power plants – Working principle of Steam, Diesel, Hydro, Nuclear power plants.

Mechanical Power Transmission - Belt Drives, Chain, Rope drives, Gear Drives and their applications.

Introduction to Robotics - Joints & links, configurations, and applications of robotics.

(Note: The subject covers only the basic principles of Civil and Mechanical Engineering systems. The evaluation shall be intended to test only the fundamentals of the subject.)

Textbooks:

1. Internal Combustion Engines by V.Ganesan, By Tata McGraw Hill publications (India)Pvt. Ltd.
2. A text book of Theory of Machines by S.S. Rattan, Tata McGraw Hill Publications,(India) Pvt. Ltd.
3. An introduction to Mechanical Engg by Jonathan Wicker and Kemper Lewis, Cengagelearning India Pvt. Ltd.

Reference Books:

1. G. Shanmugam and M.S.Palanisamy, Basic Civil and the Mechanical Engineering, Tata McGraw Hill publications (India) Pvt. Ltd.
2. Thermal Engineering by Mahesh M Rathore Tata McGraw Hill publications (India) Pvt.Ltd.
3. 3D printing & Additive Manufacturing Technology- L. Jyothish Kumar, Pulak M Pandey, Springer publications
4. Appuu Kuttan KK, Robotics, I.K. International Publishing House Pvt. Ltd. Volume-I

B.Tech. (I Sem.)

23ME01- ENGINEERING GRAPHICS

(Common to All Branches of Engineering)

L	T	P	C
2	0	2	3

Course Objectives:

- To enable the students with various concepts like dimensioning, conventions andstandards related to Engineering Drawing
- To impart knowledge on the projection of points, lines and plane surfaces
- To improve the visualization skills for better understanding of projection of solids
- To develop the imaginative skills of the students required to understand Section of solids and Developments of surfaces.
- To make the students understand the viewing perception of a solid object in Isometric and Perspective projections.

Course Outcomes:

CO1: Understand the principles of engineering drawing, including engineering curves, scales, orthographic and isometric projections. (**Understand**)

CO2: Draw and interpret orthographic projections of points, lines, planes and solids in front, topand side views. (**Apply**)

CO3: Understand and draw projection of solids in various positions in first quadrant. (**Apply**)

CO4: Able to draw the development of surfaces of simple objects (**Apply**)

CO5: Prepare isometric and orthographic sections of simple solids. (**Apply**)

UNIT I

Introduction: Lines, Lettering and Dimensioning, Geometrical Constructions and Constructing regular polygons by general methods. **(Covered theoretically in class. Not for the end examination)**

Scales: Plain scales, diagonal scales and vernier scales. **(Covered theoretically in class. Not for the endexamination)**

Curves: Construction of ellipse, parabola and hyperbola by general method only, Cycloids, Involutes,Normal and tangent to Curves.

Orthographic Projections: Reference plane, importance of reference lines or Plane, Projections of apoint situated in any one of the four quadrants.

UNIT II

Projections of Straight Lines: Projections of straight lines parallel to both reference planes, perpendicular to one reference plane and parallel to other reference plane, inclined to one reference plane and parallel to the other reference plane. Projections of Straight Line Inclined to both the reference planes.

Projections of Planes: Regular planes Perpendicular to both reference planes, parallel to one reference plane and inclined to the other reference plane.

UNIT III

Projections of Solids: Types of solids: Polyhedra and Solids of revolution. Projections of solids in

simple positions: Axis perpendicular to horizontal plane, Axis perpendicular to vertical plane and Axis parallel toboth the reference planes, Projection of Solids with axis inclined to one reference plane and parallel to another plane.

UNIT IV

Sections of Solids: Perpendicular and inclined section planes, Sectional views and True shape of section, Sections of solids in simple position only.

Development of Surfaces: Methods of Development: Parallel line development and radial line development. Development of a cube, prism, cylinder, pyramid and cone.

UNIT V

Conversion of Views: Conversion of isometric views to orthographic views; Conversion of orthographic views to isometric views.

Computer graphics: Creating 2D&3D drawings of objects including PCB and Transformations using Auto CAD **(*Not for end examination*).**

Textbook:

1. N. D. Bhatt, Engineering Drawing, Charotar Publishing House, 2016.

Reference Books:

1. Engineering Drawing, K.L. Narayana and P. Kannaiah, Tata McGraw Hill, 2013.
2. Engineering Drawing, M.B.Shah and B.C. Rana, Pearson Education Inc,2009.
3. Engineering Drawing with an Introduction to AutoCAD, DhananjayJolhe, Tata McGraw Hill, 2017.

B.Tech. (I Sem.)

23FE51- COMMUNICATIVE ENGLISH LAB

(Common to All Branches of Engineering)

L	T	P	C
0	0	2	1

Course Objectives:

The main objective of introducing this course, Communicative English Laboratory, is to expose the students to a variety of self-instructional, learner friendly modes of language learning. Thestudents will get trained in basic communication skills and also make them ready to face job interviews.

Course Outcomes:

CO1	Understand the different aspect of the English language proficiency with emphasis on LSRW skills.	**Understand**
CO2	Apply Communication Skills through various language learning activities.	**Apply**
CO3	Identifying the English speech sounds, stress, rhythm, intonation and syllable division for better listening and speaking, comprehension.	**Understand**
CO4	Exhibit professionalism in participating in debates and group discussions.	**Apply**

List of Topics:

1. Vowels & Consonants
2. Neutralization/Accent Rules
3. Communication Skills & JAM
4. Role Play or Conversational Practice
5. E-mail Writing
6. Resume Writing, Cover letter, SOP
7. Group Discussions-methods & practice
8. Debates - Methods & Practice
9. PPT Presentations/ Poster Presentation
10. Interviews Skills

Suggested Software:

- Walden Infotech
- Young India Films

Reference Books:

1. Raman Meenakshi, Sangeeta-Sharma. *Technical Communication*. Oxford Press.2018.
2. Taylor Grant: *English Conversation Practice*, Tata McGraw-Hill Education India,2016
3. Hewing's, Martin. Cambridge *Academic English* (B2). CUP, 2012.
4. J. Sethi & P.V. Dhamija. *A Course in Phonetics and Spoken English*, (2nd Ed),Kindle, 2013

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

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

B.Tech. (I Sem.)

23FE53- ENGINEERING PHYSICS LAB

(Common to All Branches of Engineering)

L	T	P	C
0	0	2	1

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: Analyze the wave properties of light using optical instruments (**Apply**).
CO2: Estimate the elastic modulii of various materials and acceleration due to gravity (**Apply**).
CO3: Demonstrate the vibrations in stretched strings (**Understand**).
CO4: Evaluate dielectric constant and magnetic field of circular coil carrying current (**Apply**).
CO5: Examine the characteristics of semiconductor devices (**Apply**).

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. Verification of Brewster's law
4. Determination of dielectric constant using charging and discharging method.
5. Study the variation of B versus H by magnetizing the magnetic material (B-H curve).
6. Determination of wavelength of Laser light using diffraction grating.
7. Estimation of Planck's constant using photoelectric effect.
8. Determination of the resistivity of semiconductors by four probe methods.
9. Determination of energy gap of a semiconductor using p-n junction diode.
10. Magnetic field along the axis of a current carrying circular coil by Stewart Gee's Method.
11. Determination of Hall voltage and Hall coefficient of a given semiconductor using Hall effect.
12. Determination of temperature coefficients of a thermistor.
13. Determination of acceleration due to gravity and radius of Gyration by using acompound pendulum.
14. Determination of magnetic susceptibility by Kundt's tube method.
15. Determination of rigidity modulus of the material of the given wire using Torsional pendulum.
16. Sonometer: Verification of laws of stretched string.
17. Determination of young's modulus for the given material of wooden scale by non-uniform bending (or double cantilever) method.
18. Determination of Frequency of electrically maintained tuning fork by Melde's experiment.

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

References:

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

Web Resources

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

L	T	P	C
0	0	2	1

B.Tech. (I Sem.)

23IT51- IT WORKSHOP

(Common to All Branches of Engineering)

Course Objectives:

- To introduce the internal parts of a computer, peripherals, I/O ports, connecting cables
- To demonstrate configuring the system as Dual boot both Windows and other Operating Systems Viz. Linux, BOSS
- To teach basic command line interface commands on Linux.
- To teach the usage of Internet for productivity and self-paced life-long learning
- To introduce Compression, Multimedia and Antivirus tools and Office Tools such asWord processors, Spread sheets and Presentation tools.

Course Outcomes:

CO1: Identify the components of a PC and troubleshooting the malfunctioning of PC. **(Apply)**
CO2: Develop presentation /documentation using Office tools and LaTeX. **(Apply)**
CO3: Build dialogs and documents using ChatGPT. **(Apply)**
CO4: Improve individual / teamwork skills, communication and report writing skills with ethical values.

PC Hardware & Software Installation

Task 1: Identify the peripherals of a computer, components in a CPU and its functions. Draw the block diagram of the CPU along with the configuration of each peripheral and submit to your instructor.

Task 2: Every student should disassemble and assemble the PC back to working condition. Lab instructors should verify the work and follow it up with a Viva. Also students need to go throughthe video which shows the process of assembling a PC. A video would be given as part of the course content.

Task 3: Every student should individually install MS windows on the personal computer. Lab instructor should verify the installation and follow it up with a Viva.

Task 4: Every student should install Linux on the computer. This computer should have windows installed. The system should be configured as dual boot (VMWare) with bothWindows and Linux. Lab instructors should verify the installation and follow it up with a Viva

Task 5: Every student should install BOSS on the computer. The system should be configuredas dual boot (VMWare) with both Windows and BOSS. Lab instructors should verify the installation and follow it up with a Viva

Internet & World Wide Web

Task1: Orientation & Connectivity Boot Camp: Students should get connected to their Local Area Network and access the Internet. In the process they configure the TCP/IP setting. Finallystudents should demonstrate, to the instructor, how to access the websites and email. If there is no internet connectivity preparations need to be made by the instructors to simulate the WWWon the LAN.

Task 2: Web Browsers, Surfing the Web: Students customize their web browsers with the LANproxy settings, bookmarks, search toolbars and pop up blockers. Also, plug-ins like Macromedia Flash and JRE for applets should be configured.

Task 3: Search Engines & Netiquette: Students should know what search engines are and how to use the search engines. A few topics would be given to the students for which they need to search on Google. This should be demonstrated to the instructors by the student.

Task 4: Cyber Hygiene: Students would be exposed to the various threats on the internet and would be asked to configure their computer to be safe on the internet. They need to customize their browsers to block pop ups, block active x downloads to avoid viruses and/or worms.

LaTeX and WORD

Task 1 – Word Orientation: The mentor needs to give an overview of La TeX and Microsoft (MS) office or equivalent (FOSS) tool word: Importance of La TeX and MS office or equivalent(FOSS) tool Word as word Processors, Details of the four tasks and features that would be covered in each, Using La TeXand word – Accessing, overview of toolbars, saving files, Usinghelp and resources, rulers, format painter in word.

Task 2: Using La TeX and Word to create a project certificate. Features to be covered:- Formatting Fonts in word, Drop Cap in word, Applying Text effects, Using Character Spacing, Borders and Colors, Inserting Header and Footer, Using Date and Time option in both La TeXand Word.

Task 3: Creating project abstract Features to be covered:-Formatting Styles, Inserting table, Bullets and Numbering, Changing Text Direction, Cell alignment, Footnote, Hyperlink, Symbols, Spell Check, Track Changes.

Task 4: Creating a Newsletter: Features to be covered:- Table of Content, Newspaper columns, Images from files and clipart, Drawing toolbar and Word Art, Formatting Images, Textboxes, Paragraphs and Mail Merge in word.

EXCEL

Excel Orientation: The mentor needs to tell the importance of MS office or equivalent (FOSS)tool Excel as a Spreadsheet tool, give the details of the four tasks and features that would be covered in each. Using Excel – Accessing, overview of toolbars, saving excel files, Using helpand resources.

Task 1: Creating a Scheduler - Features to be covered: Gridlines, Format Cells, Summation, auto fill, Formatting Text

Task 2: Calculating GPA -. Features to be covered:- Cell Referencing, Formulae in excel – average, std. deviation, Charts, Renaming and Inserting worksheets, Hyper linking, Count function,

LOOKUP/VLOOKUP

Task 3: Split cells, freeze panes, group and outline, Sorting, Boolean and logical operators, Conditional formatting

POWER POINT

Task 1: Students will be working on basic power point utilities and tools which help them create basic power point presentations. PPT Orientation, Slide Layouts, Inserting Text, Word Art, Formatting Text, Bullets and Numbering, Auto Shapes, Lines and Arrows in PowerPoint.

Task 2: Interactive presentations - Hyperlinks, Inserting –Images, Clip Art, Audio, Video, Objects, Tables and Charts.

Task 3: Master Layouts (slide, template, and notes), Types of views (basic, presentation, slide slotter, notes etc), and Inserting – Background, textures, Design Templates, Hidden slides.

AI TOOLS – ChatGPT

Task 1: Prompt Engineering: Experiment with different types of prompts to see how the model responds. Try asking questions, starting conversations, or even providing incomplete sentencesto see how the model completes them.

- Ex: Prompt: "You are a knowledgeable AI. Please answer the following question: What is the capital of France?"

Task 2: Creative Writing: Use the model as a writing assistant. Provide the beginning of a storyor a description of a scene, and let the model generate the rest of the content. This can be a fun way to brainstorm creative ideas

- Ex: Prompt: "In a world where gravity suddenly stopped working, people started floating upwards. Write a story about how society adapted to this new reality."

Task 3: Language Translation: Experiment with translation tasks by providing a sentence in one language and asking the model to translate it into another language. Compare the output tosee how accurate and fluent the translations are.

- Ex:Prompt: "Translate the following English sentence to French: 'Hello, how are you doing today?'"

Reference Books:

1. Comdex Information Technology course tool kit, Vikas Gupta, WILEY Dream tech, 2003
2. The Complete Computer upgrade and repair book, Cheryl A Schmidt, WILEY Dream tech, 2013, 3rd edition
3. Introduction to Information Technology, ITL Education Solutions limited, Pearson Education, 2012, 2nd edition
4. PC Hardware - A Handbook, Kate J. Chase, PHI (Microsoft)
5. LaTeX Companion, Leslie Lamport, PHI/Pearson.
6. IT Essentials PC Hardware and Software Companion Guide, David Anfins on and Ken Quamme. – CISCO Press, Pearson Education, 3rd edition
7. IT Essentials PC Hardware and Software Labs and Study Guide, Patrick Regan– CISCO Press, Pearson Education, 3rd edition

B.Tech. (I Sem.)

23ME51- ENGINEERING WORKSHOP

(Common to All Branches of Engineering)

L	T	P	C
0	0	3	1.5

Course Objectives:

To familiarize students with wood working, sheet metal operations, fitting, electrical housewiring skills, and basic repairs of two-wheeler vehicle.

Course Outcomes:

CO1: Identify workshop tools and their operational capabilities. (**Remember**)

CO2: Practice on manufacturing of components using workshop trades including fitting, carpentry, foundry, and welding. (**Understand**)

CO3: Modal various basic prototypes in fitting trade. (**Apply**)

CO4: Apply basic electrical engineering knowledge for House Wiring Practice (**Apply**)

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 joint or Bridlejoint
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 followingfitting exercises.
   a. V-fit b) Dovetail fit c) Semi-circular fit d) Bicycle tire punctureand change of two-wheeler tyre
5. **Electrical Wiring**: Familiarity with different types of basic electrical circuits and makethe 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 jointswith coupling for same diameter and with reducer for different diameters.
9. **Basic repairs of Two-wheeler vehicle** – Demonstration of working of two-wheeler vehicle and its repairs.

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, Media Promoters 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

L	T	P	C
-	-	1	0.5

B.Tech. (I Sem.)

23AU02- NSS/NCC/SCOUTS & GUIDES/COMMUNITY SERVICE

(Common to All Branches of Engineering)

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. **(Understand)**

CO2: Solve some societal issues by applying acquired knowledge, facts, and techniques. **(Apply)**

CO3: Explore human relationships by analyzing social problems. **(Understand)**

CO4: Determine to extend their help for the fellow beings and downtrodden people **(Apply)**

CO5: Develop leadership skills and civic responsibilities. **(Apply)**

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-releasingroad 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 & CareActivities:

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 ServiceActivities:

i. Conducting One Day Special Camp in a village contacting village-area leaders- Surveyin 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 EnvironmentalEngineering 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, totaling to 90 marks.
- A student shall be evaluated by the concerned teacher for 10 marks by conducting viva voce on the subject.

L	T	P	C
3	0	0	3

B.Tech. (II Sem.)

23FE05- DIFFERENTIAL EQUATIONS & VECTOR CALCULUS

(Common to All Branches of Engineering)

Course Objectives:

- To enlighten the learners in the concept of differential equations and multivariablecalculus.
- To furnish the learners with basic concepts and techniques at plus two level to lead them into advanced level by handling various real-world applications.

Course Outcomes: At the end of the course, the student will be able to

CO1	Solve the differential equations related to various engineering fields (Unit – I&II)	**Apply**
CO2	Apply knowledge of partial differentiation in modelling and solving of Partial differential equations.	**Apply**
CO3	Interpret the physical meaning of different operators such as gradient, curl and divergence.	**Apply**
CO4	Evaluate the work done against a field, circulation and flux using Vector Calculus.	**Apply**

UNIT I Differential equations of first order and first degree

Linear differential equations – Bernoulli's equations- Exact equations and equations reducible to exact form. Applications: 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 solution, particular integral, Wronskian, Method of variation of parameters. Simultaneous linear equations, Applications to L-C-R Circuit problems and Simple Harmonic motion.

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, Directional derivative, del applied to vector point functions-Divergence and Curl, vector identities.

UNIT V Vector integration

LWithoutegral-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 related problems.

Textbooks:

1. Higher Engineering Mathematics, B. S. Grewal, Khanna Publishers, 2017, 44th Edition
2. Advanced Engineering Mathematics, Erwin Kreyszig, John Wiley & Sons, 2018, 10th Edition.

Reference Books:

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

L	T	P	C
3	0	0	3

B.Tech. (II Sem.)

23FE06- ENGINEERING CHEMISTRY

(Common to Civil, Chemical, Mechanical Engineering and allied branches)

Course Objectives:

- To enable the students to understand the fundamental concepts of chemistry and to provide themwith the knowledge of industrial problems and finding the solutions.
- To understand quality of water, fuels for various applications, polymers, electrochemistry and batteries.
- To learn the basic concepts of surface chemistry and identify the significance of modern engineeringmaterials.

Course Outcomes: At the end of the course, the students will be able to

CO1: Identify the troubles due to hardness of water and its maintenance in industrial applications. (**Understand**)

CO2: Apply Nernst equation in calculating cell potentials, compare batteries for different applications and outline the principles of corrosion for design and effective maintenance of various devices. (**Understand**)

CO3: Outline the importance of polymers and alternate fuels. (**Understand**)

CO4: Summarize the suitability of engineering materials like composites, refractories, lubricants, and building materials. (**Understand**)

CO5: Understand the concepts of collides, micelles and nanomaterials. (**Understand**)

UNIT I Water Technology

Soft and hardwater, 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 electrodialysis.

UNIT II Electrochemistry and Applications

Electrodes –electrochemical cell, Nernst equation, cell potential calculations.

Primary cells – Zinc-air battery, Secondary cells – Nickel-Cadmium (NiCad),and lithium ion 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 electrochemical corrosion, Pilling Bedworth ratios and uses, Factors affecting the corrosion**,** cathodic and anodic protection, electroplating and electro less plating (Nickel and Copper).

UNIT III 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, 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 IV 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.

UNIT V Surface Chemistry and Nanomaterials

Introduction to surface chemistry, colloids, nanometals and nanometal oxides, micelle formation, synthesis of colloids (Braggs Method), chemical and biological methods of preparation of nanometals and metal oxides, stabilization of colloids and nanomaterials by stabilizing agents, adsorption isotherm (Freundlich and Longmuir), BET equation (no derivation) applications of colloids and nanomaterials – catalysis, medicine, sensors, etc.

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

L	T	P	C
3	0	0	3

B.Tech. (II Sem.)

23EE01- BASIC ELECTRICAL & ELECTRONICS ENGINEERING

(Common to All branches of Engineering)

Course Objectives:

To expose to the field of electrical & electronics engineering, laws and principles of electrical/electronic engineering and to acquire fundamental knowledge in the relevant field.

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

CO1: Extract electrical variables of AC & DC circuits using fundamental laws. **(Understand)**

CO2: Understand the operation of electrical machines and measuring instruments. **(Understand)**

CO3: Classify various energy resources, safety measures and interpret electricity bill generation in electrical systems. **(Understand)**

PART A: BASIC ELECTRICAL ENGINEERING

UNIT I DC & AC Circuits

DC Circuits: Electrical circuit elements (R, L and C), Ohm's Law and its limitations, KCL &KVL, series, parallel, series-parallel circuits, Super Position theorem, Simple numerical problems.

AC Circuits: A.C. Fundamentals: Equation of AC Voltage and current, waveform, time period, frequency, amplitude, phase, phase difference, average value, RMS value, form factor, peak factor, Voltage and current relationship with phasor diagrams in R, L, and C circuits, Concept of Impedance, Active power, reactive power and apparent power, Concept of power factor (Simple Numerical problems).

UNIT II Machines and Measuring Instruments

Machines: Construction, principle and operation of (i) DC Motor, (ii) DC Generator, (iii) Single Phase Transformer, (iv) Three Phase Induction Motor and (v) Alternator, Applications of electrical machines.

Measuring Instruments: Construction and working principle of Permanent Magnet Moving Coil (PMMC), Moving Iron (MI) Instruments and Wheat Stone bridge.

UNIT III Energy Resources, Electricity Bill & Safety Measures

Energy Resources: Conventional and non-conventional energy resources; Layout and operation of various Power Generation systems: Hydel, Nuclear, Solar & Wind power generation.

Electricity bill: Power rating of household appliances including air conditioners, PCs, Laptops, Printers, etc. Definition of "unit" used for consumption of electrical energy, two-part electricitytariff, calculation of electricity bill for domestic consumers.

Equipment Safety Measures: Working principle of Fuse and Miniature circuit breaker (MCB), merits and demerits. Personal safety measures: Electric Shock, Earthing and its types, Safety Precautions to avoid shock.

Textbooks:

1. Basic Electrical Engineering, D. C. Kulshreshtha, Tata McGraw Hill, 2019, First Edition
2. Power System Engineering, P.V. Gupta, M.L. Soni, U.S. Bhatnagar and A. Chakrabarti, Dhanpat Rai & Co, 2013
3. Fundamentals of Electrical Engineering, Rajendra Prasad, PHI publishers, 2014, Third

Edition

Reference Books:

1. Basic Electrical Engineering, D. P. Kothari and I. J. Nagrath, Mc Graw Hill, 2019,Fourth Edition
2. Principles of Power Systems, V.K. Mehtha, S.Chand Technical Publishers, 2020
3. Basic Electrical Engineering, T. K. Nagsarkar and M. S. Sukhija, Oxford UniversityPress, 2017
4. Basic Electrical and Electronics Engineering, S. K. Bhatacharya, Person Publications,2018, Second Edition.

Web Resources:

1. https://nptel.ac.in/courses/108105053
2. https://nptel.ac.in/courses/108108076

PART B: BASIC ELECTRONICS ENGINEERING

Course Objectives:

- To teach the fundamentals of semiconductor devices and its applications, principles of digital electronics.

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

CO4: Interpret the characteristics of various semiconductor devices **(Knowledge)**

CO5: Infer the operation of rectifiers, amplifiers. **(Understand)**

CO6: Contrast various logic gates, sequential and combinational logic circuits. **(Understand)**

UNIT I SEMICONDUCTOR DEVICES

Introduction - Evolution of electronics – Vacuum tubes to nano electronics - Characteristics ofPN Junction Diode — Zener Effect — Zener Diode and its Characteristics. Bipolar Junction Transistor — CB, CE, CC Configurations and Characteristics — Elementary Treatment of Small Signal CE Amplifier.

UNIT II BASIC ELECTRONIC CIRCUITS AND INSTRUMENTTAION

Rectifiers and power supplies: Block diagram description of a dc power supply, working of a full wave bridge rectifier, capacitor filter (no analysis), working of simple zener voltage regulator. Amplifiers: Block diagram of Public Address system, Circuit diagram and working of common emitter (RC coupled) amplifier with its frequency response. Electronic Instrumentation: Block diagram of an electronic instrumentation system.

UNIT III DIGITAL ELECTRONICS

Overview of Number Systems, Logic gates including Universal Gates, BCD codes, Excess-3 code, Gray code, Hamming code. Boolean Algebra, Basic Theorems and properties of Boolean Algebra, Truth Tables and Functionality of Logic Gates – NOT, OR, AND, NOR, NAND, XOR and XNOR. Simple combinational circuits–Half and Full Adders. Introduction to sequential circuits, Flip flops, Registers and counters (Elementary Treatment only)

Textbooks:

1. R. L. Boylestad & Louis Nashlesky, Electronic Devices & Circuit Theory, Pearson Education, 2021.
2. R. P. Jain, Modern Digital Electronics, 4th Edition, Tata Mc Graw Hill, 2009

Reference Books:

1. R. S. Sedha, A Textbook of Electronic Devices and Circuits, S. Chand & Co, 2010.
2. Santiram Kal, Basic Electronics- Devices, Circuits and IT Fundamentals, Prentice Hall,India, 2002.
3. R. T. Paynter, Introductory Electronic Devices & Circuits – Conventional Flow Version, Pearson Education,2009.

End examination pattern:

i) Question paper shall be in two parts viz., Part A and Part B with equal weightage of 35marks each.
ii) In each part, question 1 shall contain 5 compulsory short answer questions for a total of5 marks such that each question carries 1 mark.
iii) In each part, questions from 2 to 4, there shall be either/or type questions of 10 markseach. Student shall answer any one of them.
iv) The questions from 2 to 4 shall be set by covering one unit of the syllabus for eachquestion.

L	T	P	C
3	0	0	3

B.Tech. (II Sem.)

23CS01- INTRODUCTION TO PROGRAMMING

(Common to All branches of Engineering)

Course Objectives:

- To introduce students to the fundamentals of computer programming.
- To provide hands-on experience with coding and debugging.
- To foster logical thinking and problem-solving skills using programming.
- To familiarize students with programming concepts such as data types, controlstructures, functions, and arrays.
- To encourage collaborative learning and teamwork in coding projects.

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

CO1: Understand basics of computers, concept of algorithms and flowcharts. (**Understand)**

CO2: Understand the features of C language. (**Understand**)

CO3: Interpret the problem and develop an algorithm to solve it. (**Apply**)

CO4: Implement various algorithms using the C programming language. (**Apply**)

CO5: Develop skills required for problem-solving and optimizing the code (**Apply)**

UNIT I Introduction to Programming and Problem Solving

History of Computers, Basic organization of a computer: ALU, input-output units, memory, program counter, Introduction to Programming Languages, Basics of a Computer Program-Algorithms, flowcharts (Using Dia Tool), pseudo code. Introduction to Compilation andExecution, Primitive Data Types, Variables, and Constants, Basic Input and Output, Operations, Type Conversion, and Casting.

Problem solving techniques: Algorithmic approach, characteristics of algorithm, Problem solving strategies: Top-down approach, Bottom-up approach, Time and space complexities of algorithms.

UNIT II Control Structures

Simple sequential programs Conditional Statements (if, if-else, switch), Loops (for, while, do-while) Break and Continue.

UNIT III Arrays and Strings

Arrays indexing, memory model, programs with array of integers, two dimensional arrays, Introduction to Strings.

UNIT IV Pointers & User Defined Data types

Pointers, dereferencing and address operators, pointer and address arithmetic, array manipulation using pointers, User-defined data types-Structures and Unions.

UNIT V Functions & File Handling

Introduction to Functions, Function Declaration and Definition, Function call Return Types and Arguments, modifying parameters inside functions using pointers, arrays as parameters. Scopeand Lifetime of Variables, Basics of File Handling

Note: The syllabus is designed with C Language as the fundamental language ofimplementation**.**

Textbooks:

1. "The C Programming Language", Brian W. Kernighan and Dennis M. Ritchie, Prentice- Hall, 1988
2. Schaum's Outline of Programming with C, Byron S Gottfried, McGraw-Hill Education,1996

Reference Books:

1. Computing fundamentals and C Programming, Balagurusamy, E., McGraw-HillEducation, 2008.
2. Programming in C, Rema Theraja, Oxford, 2016, 2nd edition
3. C Programming, A Problem Solving Approach, Forouzan,Gilberg, Prasad,CENGAGE, 3rd edition

L	T	P	C
3	0	0	3

B.Tech. (II Sem.)

23ME02- ENGINEERING MECHANICS

(Common to Civil, Mechanical Engineering & Allied branches)

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 inertia and 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 of rigid bodies.

Course Outcomes: On Completion of the course, the student should be able to

CO1: Determine the resultant of coplanar concurrent and non-concurrent force systems (**Apply**)

CO2: Apply static equilibrium conditions to determine unknown planar force systems and determine the frictional forces for bodies in contact. (**Apply**)

CO3: Calculate the centroids, center of gravity and moment of inertia of different geometrical shapes. (**Apply**)

CO4: Apply the principles of work-energy and impulse-momentum to solve the problems of rectilinear and curvilinear motion of a particle. (**Apply**)

CO5: Solve the problems involving the translational and rotational motion of rigid bodies. (**Apply**)

UNIT I

Introduction to Engineering Mechanics– Introduction, Basic Terminology in mechanics, Laws of mechanics, Characteristics of forces, resolution & composition of forces.

Systems of Forces: Coplanar Concurrent Forces– Coplanar Non-Concurrent Forces, moment of force, applications- Couples and Resultant of Force Systems.

UNIT II

Equilibrium of Systems of Forces: Free Body Diagrams, Lami's Theorem, Equations of Equilibrium of Coplanar Systems, Triangle law of forces, polygon law of forces condition of equilibrium, Analysis of plane trusses, Principle of virtual work with simple examples.

Friction: Introduction, Coulomb's laws of dry friction, coefficient of friction, Cone of Static friction,limiting friction and impending motion of blocks resting on horizontal and inclined planes.

UNIT III

Centroid: Centroids of simple figures (from basic principles)–Centroids of I, T, C, L Sections.

Centre of Gravity: Centre of gravity of simple bodies (from basic principles).

Area Moments of Inertia: Definition, Moment of inertia of I, T, C, L Sections– Polar Moment ofInertia, Transfer Theorem.

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

UNIT IV

Rectilinear and Curvilinear motion of a particle: Introduction to Kinematics and Kinetics, Generalprinciples in dynamics, Rectilinear and curvilinear motions- motion with uniform velocity, uniform acceleration and non-uniform acceleration – D'Alembert's Principle - Work Energy method and applications to particle motion-Impulse Momentum method (theory only).

UNIT V

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

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.
4. G. Kraige., John Wiley, 2008. 6th Edition.
5. Introduction to Statics and Dynamics, Basudev Battachatia, Oxford University Press,2014. Second Edition
6. Engineering Mechanics: Statics and Dynamics, Hibbeler R.C., Pearson Education, Inc.,New Delhi, 2022, 14th Edition

B.Tech. (II Sem.)

23FE54- ENGINEERING CHEMISTRY LAB

(Common to Civil, Chemical, Mechanical Engineering & Allied branches)

L	T	P	C
0	0	2	1

Course Objectives:

- To enable the students to analyze water samples and perform different types of volumetric titrations.
- To provides an overview of preparation of polymers, nanomaterials and analytical techniques.
- To measure the important parameters of fuels, lubricants and composition of cement.

Course Outcomes: At the end of the course, the students will be able to

CO1: Analyze important parameters of water to check its suitability for drinking purposes and industrial applications. **(Analyze)**

CO2: Acquire practical knowledge related to preparation of Bakelite and nanomaterials. **(Apply)**

CO3: Distinguish different types of titrations in volumetric analysis after performing the experiments listed in the syllabus. **(Apply)**

CO4: To estimate the amount of calcium in cement and the strength of acid present in Pb-Acid battery. **(Apply)**

CO5: Improve individual / teamwork skills, communication and report writing skills with ethical values. **(Apply)**

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
4. Preparation of a polymer (Bakelite)
5. Determination of percentage of Iron in Cement 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

Reference:

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

L	T	P	C
0	0	3	1.5

B.Tech. (II Sem.)

23EE51- ELECTRICAL & ELECTRONICS ENGINEERING WORKSHOP

(Common to All branches of Engineering)

Course Objectives:

To impart knowledge on the fundamental laws & theorems of electrical circuits, functions ofelectrical machines and energy calculations.

Course Outcomes:

After competition of this course, the student will be able to

CO1. Compute voltage, current and power in an electrical circuit. **(Apply)**

CO2. Compute medium resistance using Wheat stone bridge. **(Apply)**

CO3. Discover critical field resistance and critical speed of DC shunt generators. **(Apply)**

CO4. Estimate reactive power and power factor in electrical loads. **(Understand)**

CO5: Plot the characteristics of semiconductor devices. **(Apply)**

CO6: Demonstrate the working of various logic gates using ICs. **(Understand)**

Activities:

1. Familiarization of commonly used Electrical & Electronic Workshop Tools: Bread board, Solder, cables, relays, switches, connectors, fuses, Cutter, plier, screwdriver set, wire stripper, flux, knife/blade, soldering iron, de-soldering pump etc.
   - Provide some exercises so that hardware tools and instruments are learned to be used by the students.

2. Familiarization of Measuring Instruments like Voltmeters, Ammeters, multimeter, LCR-Q meter, Power Supplies, CRO, DSO, Function Generator, Frequency counter.
   - Provide some exercises so that measuring instruments are learned to be used by thestudents.

3. Components:
   - Familiarization/Identification of components (Resistors, Capacitors, Inductors, Diodes, transistors, IC's etc.) – Functionality, type, size, colour coding package, symbol, cost etc.
   - Testing of components like Resistor, Capacitor, Diode, Transistor, ICs etc. - Compare values of components like resistors, inductors, capacitors etc with the measured values by using instruments

PART A: ELECTRICAL ENGINEERING LAB

List of experiments:

1. Verification of KCL and KVL
2. Verification of Superposition theorem
3. Measurement of Resistance using Wheat stone bridge
4. Magnetization Characteristics of DC shunt Generator
5. Measurement of Power and Power factor using Single-phase wattmeter
6. Measurement of Earth Resistance using Megger
7. Calculation of Electrical Energy for Domestic Premises

Reference Books:

1. Basic Electrical Engineering, D. C. Kulshreshtha, Tata McGraw Hill, 2019, FirstEdition
2. Power System Engineering, P.V. Gupta, M.L. Soni, U.S. Bhatnagar and A. Chakrabarti,Dhanpat Rai & Co, 2013
3. Fundamentals of Electrical Engineering, Rajendra Prasad, PHI publishers, 2014, ThirdEdition

Note: Minimum Six Experiments to be performed.

PART B: ELECTRONICS ENGINEERING LAB

Course Objectives:

- To impart knowledge on the principles of digital electronics and fundamentals ofelectron devices & its applications.

List of Experiments:

1. Plot V-I characteristics of PN Junction diode A) Forward bias B) Reverse bias.
2. Plot V – I characteristics of Zener Diode and its application as voltage Regulator.
3. Implementation of half wave and full wave rectifiers
4. Plot Input & Output characteristics of BJT in CE and CB configurations
5. Frequency response of CE amplifier.
6. Simulation of RC coupled amplifier with the design supplied
7. Verification of Truth Table of AND, OR, NOT, NAND, NOR, Ex-OR, Ex-NOR gatesusing ICs.
8. Verification of Truth Tables of S-R, J-K& D flip flops using respective ICs.

Tools / Equipment Required: DC Power supplies, Multi meters, DC Ammeters, DC Voltmeters,AC Voltmeters, CROs, all the required active devices.

References:

1. R. L. Boylestad & Louis Nashlesky, Electronic Devices & Circuit Theory, PearsonEducation,2021.
2. R. P. Jain, Modern Digital Electronics, 4th Edition, Tata Mc Graw Hill, 2009
3. R. T. Paynter, Introductory Electronic Devices & Circuits – Conventional Flow Version,PearsonEducation,2009.

Note: Minimum Six Experiments to be performed. All the experiments shall be implementedusing both Hardware and Software.

B.Tech. (II Sem.)	23CS51- COMPUTER PROGRAMMING LAB (Common to All branches of Engineering)	L	T	P	C
		0	0	3	1.5

Course Objectives:

The course aims to give students hands – on experience and train them on the concepts of the C- programming language.

Course Outcomes:

CO1: Read, understand, and trace the execution of programs written in C language. (**Understand)**
CO2: Apply the right control structure for solving the problem. (**Apply**)
CO3: Develop, Debug and Execute programs to demonstrate the applications of arrays, functions,pointers and files in C. (**Apply**)
CO4: Improve individual / teamwork skills, communication and report writing skills with ethicalvalues.

UNIT I

WEEK 1

Objective: Getting familiar with the programming environment on the computer andwriting the first program.

Suggested Experiments/Activities:

Tutorial 1: Problem-solving using Computers.

Lab1: Familiarization with programming environment

i. Basic Linux environment and its editors like Vi, Vim & Emacs etc.
ii. Exposure to Turbo C, gcc
iii. Writing simple programs using printf(), scanf()

WEEK 2

Objective: Getting familiar with how to formally describe a solution to a problem in aseriesof finite steps both using textual notation and graphic notation.

Suggested Experiments /Activities:

Tutorial 2: Problem-solving using Algorithms and Flow charts.

Lab 1: Converting algorithms/flow charts into C Source code.

Developing the algorithms/flowcharts for the following sample programs

i. Sum and average of 3 numbers
ii. Conversion of Fahrenheit to Celsius and vice versa
iii. Simple interest calculation

WEEK 3

Objective: Learn how to define variables with the desired data-type, initialize them with appropriate values and how arithmetic operators can be used with variables and constants.

Suggested Experiments/Activities:

Tutorial 3: Variable types and type conversions:

Lab 3: Simple computational problems using arithmetic expressions.

i. Finding the square root of a given number
ii. Finding compound interest

iii. Area of a triangle using heron's formulae
iv. Distance travelled by an object

UNIT II

WEEK 4

Objective: Explore the full scope of expressions, type-compatibility of variables & constants and operators used in the expression and how operator precedence works.

Suggested Experiments/Activities:

Tutorial 4: Operators and the precedence and as associativity:

Lab4: Simple computational problems using the operator' precedence and associativity

i. Evaluate the following expressions.
    a. A+B*C+(D*E) + F*G
    b. A/B*C-B+A*D/3
    c. A+++B---A
    d. J= (i++) + (++i)
ii. Find the maximum of three numbers using conditional operator
iii. Take marks of 5 subjects in integers, and find the total, average in float

WEEK 5

Objective: Explore the full scope of different variants of "if construct" namely if-else, null- else, if-else if*-else, switch and nested-if including in what scenario each one of them can be used and how to use them. Explore all relational and logical operators while writing conditionals for "if construct".

Suggested Experiments/Activities:

Tutorial 5: Branching and logical expressions:

Lab 5: Problems involving if-then-else structures.

i. Write a C program to find the max and min of four numbers using if-else.
ii. Write a C program to generate electricity bill.
iii. Find the roots of the quadratic equation.
iv. Write a C program to simulate a calculator using switch case.
v. Write a C program to find the given year is a leap year or not.

WEEK 6

Objective: Explore the full scope of iterative constructs namely while loop, do-while loop and for loop in addition to structured jump constructs like break and continue including when eachof these statements is more appropriate to use.

Suggested Experiments/Activities:

Tutorial 6: Loops, while and for loops

Lab 6: Iterative problems e.g., the sum of series

i. Find the factorial of given number using any loop.
ii. Find the given number is a prime or not.
iii. Compute sine and cos series
iv. Checking a number palindrome
v. Construct a pyramid of numbers.

UNIT III

WEEK 7:

Objective: Explore the full scope of Arrays construct namely defining and initializing 1-D and 2-D and more generically n-D arrays and referencing individual array elements from the defined array. Using integer 1-D arrays, explore search solution linear search.

Suggested Experiments/Activities:

Tutorial 7: 1 D Arrays: searching.

Lab 7:1D Array manipulation, linear search

i. Find the min and max of a 1-D integer array.
ii. Perform linear search on1D array.
iii. The reverse of a 1D integer array
iv. Find 2's complement of the given binary number.
v. Eliminate duplicate elements in an array.

WEEK 8:

Objective: Explore the difference between other arrays and character arrays that can be used as Strings by using null character and get comfortable with string by doing experiments that will reverse a string and concatenate two strings. Explore sorting solution bubble sort using integer arrays.

Suggested Experiments/Activities:

Tutorial 8: 2 D arrays, sorting and Strings.

Lab 8: Matrix problems, String operations, Bubble sort

i. Addition of two matrices
ii. Multiplication two matrices
iii. Sort array elements using bubble sort
iv. Concatenate two strings without built-in functions
v. Reverse a string using built-in and without built-in string functions

UNIT IV

WEEK 9:

Objective: Explore pointers to manage a dynamic array of integers, including memory allocation & value initialization, resizing changing and reordering the contents of an array and memory de-allocation using malloc (), calloc (), realloc () and free () functions. Gain experience processing command-line arguments received by C

Suggested Experiments/Activities:

Tutorial 9: Pointers, structures and dynamic memory allocation

Lab 9: Pointers and structures, memory dereference.

i. Write a C program to find the sum of a 1D array using malloc()
ii. Write a C program to find the total, average of n students using structures
iii. Enter n students data using calloc() and display failed students list
iv. Read student name and marks from the command line and display the student details alongwith the total.
v. Write a C program to implement realloc()

WEEK 10:

Objective: Experiment with C Structures, Unions, bit fields and self-referential structures (Singly linked lists) and nested structures

Suggested Experiments/Activities:

Tutorial 10: Bitfields, Self-Referential Structures, Linked lists

Lab10 : Bitfields, linked lists

Read and print a date using dd/mm/yyyy format using bit-fields and differentiate the same without using bit- fields

i. Create and display a singly linked list using self-referential structure.
ii. Demonstrate the differences between structures and unions using a C program.
iii. Write a C program to shift/rotate using bitfields.
iv. Write a C program to copy one structure variable to another structure of the same type.

UNIT V

WEEK 11:

Objective: Explore the Functions, sub-routines, scope and extent of variables, doing some experiments by parameter passing using call by value. Basic methods of numerical integration

Suggested Experiments/Activities:

Tutorial 11: Functions, call by value, scope and extent,

Lab 11: Simple functions using call by value, solving differential equations using Eulerstheorem.

i. Write a C function to calculate NCR value.
ii. Write a C function to find the length of a string.
iii. Write a C function to transpose of a matrix.
iv. Write a C function to demonstrate numerical integration of differential equations using Euler'smethod

WEEK 12:

Objective: Explore how recursive solutions can be programmed by writing recursive functionsthat can be invoked from the main by programming at-least five distinct problems that have naturally recursive solutions.

Suggested Experiments/Activities:

Tutorial 12: Recursion, the structure of recursive calls

Lab 12: Recursive functions

i. Write a recursive function to generate Fibonacci series.
ii. Write a recursive function to find the lcm of two numbers.
iii. Write a recursive function to find the factorial of a number.
iv. Write a C Program to implement Ackermann function using recursion.
v. Write a recursive function to find the sum of series.

WEEK 13:

Objective: Explore the basic difference between normal and pointer variables, Arithmetic operations using pointers and passing variables to functions using pointers

Suggested Experiments/Activities:

Tutorial 13: Call by reference, dangling pointers

Lab 13: Simple functions using Call by reference, Dangling pointers.

i. Write a C program to swap two numbers using call by reference.
ii. Demonstrate Dangling pointer problem using a C program.
iii. Write a C program to copy one string into another using pointer.
iv. Write a C program to find no of lowercase, uppercase, digits and other characters using pointers.

WEEK14:

Objective: To understand data files and file handling with various file I/O functions. Explore thedifferences between text and binary files.

Suggested Experiments/Activities:

Tutorial 14: File handling

Lab 14: File operations

i. Write a C program to write and read text into a file.
ii. Write a C program to write and read text into a binary file using fread() andfwrite()
iii. Copy the contents of one file to another file.
iv. Write a C program to merge two files into the third file using command-line arguments.
v. Find no. of lines, words and characters in a file
vi. Write a C program to print last n characters of a given file.

Textbooks:

1. Ajay Mittal, Programming in C: A practical approach, Pearson.
2. Byron Gottfried, Schaum' s Outline of Programming with C, McGraw Hill

Reference Books:

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice-Hall of India
2. C Programming, A Problem-Solving Approach, Forouzan, Gilberg, Prasad, CENGAGE

B.Tech. (II Sem.)

23ME52- ENGINEERING MECHANICS LAB

(Mechanical Engineering & allied branches)

L	T	P	C
0	0	3	1.5

Course Objectives: The students completing the course are expected to:

- Verify the Law of Parallelogram and Triangle of Forces.
- Determine the coefficients of friction of Static and Rolling friction and Centreof gravity of different plane Lamina.
- Analyse the system of Pulleys and Moment of Inertia of Compound Pendulum and Flywheel.

Course Outcomes:

CO1: Evaluate the coefficient of friction between two different surfaces and between the inclined plane and the roller. (**Apply**)

CO2: Verify Law of Polygon of forces and Law of Moment using force polygon and bell crank lever. (**Apply**)

CO3: Determine the Centre of gravity and Moment of Inertia of different configurations. (**Apply**)

CO4: Apply the equilibrium conditions of a rigid body under the action of different force systems (**Apply**)

Students have to perform any 10 of the following Experiments:

List of Experiments:

1. Verification of Law of Parallelogram of Forces.
2. Verification of Law of Triangle of Forces.
3. Verification of the Law of polygon for coplanar-concurrent forces acting on a particle in equilibrium and to find the value of unknown forces considering particle to be in equilibriumusing universal force table.
4. Determination of coefficient of Static and Rolling Frictions
5. Determination of Centre of Gravity of different shaped Plane Lamina.
6. Verification of the conditions of equilibrium of a rigid body under the action of coplanarnon-concurrent, parallel force system with the help of a simply supported beam.
7. Study of the systems of pulleys and draw the free body diagram of the system.
8. Determine the acceleration due to gravity using a compound pendulum.
9. Determine the Moment of Inertia of the compound pendulum about an axis perpendicular tothe plane of oscillation and passing through its centre of mass.
10. Determine the Moment of Inertia of a Flywheel.
11. Verification of Law of Moment using Rotation Disc Apparatus and Bell Crank Lever.

References:

1. S. Timoshenko, D. H. Young, J.V. Rao, S. Pati., Engineering Mechanics, 5th Edition, McGrawHill Education.
2. Hibbeler R.C., Engineering Mechanics: Statics and Dynamics, 14th Edition, Pearson Education,Inc., New Delhi, 2022

L	T	P	C
0	0	1	0.5

B.Tech. (II Sem.)

23AU01- HEALTH AND WELLNESS, YOGA AND SPORTS

(Common to All branches of Engineering)

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. **(Understand)**

CO2: Demonstrate an understanding of health-related fitness components. **(Apply)**

CO3: Compare and contrast various activities that help enhance their health.**(Understand)**

CO4: Assess current personal fitness levels. **(Apply)**

CO5: Develop Positive Personality **(Apply)**

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.
ii. Practicing general and specific warm up, aerobics
iii. Practicing cardiorespiratory fitness, treadmill, run test, 9 min walk, skipping andrunning.

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 manyas 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 vivavoce on the subject.

B.Tech. (III Sem.)

23FE09- NUMERICAL METHODS AND TRANSFORM TECHNIQUES

(Common to All branches of Engineering)

L	T	P	C
3	0	0	3

Course Objectives:

- To elucidate the different numerical methods to solve nonlinear algebraic equations
- To disseminate the use of different numerical techniques for carrying out numericalintegration.
- To furnish the learners with basic concepts and techniques at plus two level to leadthem into advanced level by handling various real world applications.

Course Outcomes:

1. Evaluate the approximate roots of polynomial and transcendental equations by different algorithms. Apply Newton's forward & backward interpolation and Lagrange's formulae for equal and unequal intervals (L3)
2. Apply numerical integral techniques to different Engineering problems. Apply different algorithms for approximating the solutions of ordinary differential equations with initial conditions to its analytical computations (L3)
3. Apply the Laplace transform for solving differential equations (L3)
4. Find or compute the Fourier series of periodic signals (L3)
5. Know and be able to apply integral expressions for the forwards and inverse Fourier transform to a range of non-periodic waveforms (L3)

UNIT – I: Iterative Methods:

Introduction – Solutions of algebraic and transcendental equations: Bisection method – Secant method – Method of false position – Iteration method – Newton-Raphson method (Simultaneous Equations)

Interpolation: Newton's forward and backward formulae for interpolation – Interpolation with unequal intervals – Lagrange's interpolation formula

UNIT – II: Numerical integration, Solution of ordinary differential equations with initial conditions:

Trapezoidal rule– Simpson's $1/3^{rd}$ and $3/8^{th}$ rule– Solution of initial value problems by Taylor's series– Picard's method of successive approximations– Euler's method –Runge-Kutta method (second and fourth order) – Milne's Predictor and Corrector Method.

UNIT –III: Laplace Transforms:

Definition of Laplace transform - Laplace transforms of standard functions – Properties of Laplace Transforms – Shifting theorems–Transforms of derivatives and integrals – Unit step function – Dirac's delta function – Inverse Laplace transforms – Convolution theorem (with out proof).

Applications: Solving ordinary differential equations (initial value problems) and integro differential equations using Laplace transforms.

UNIT – IV: Fourier series:

Introduction– Periodic functions – Fourier series of periodic function –Dirichlet's conditions

– Even and odd functions –Change of interval– Half-range sine and cosine series.

UNIT – V: Fourier Transforms:

Fourier integral theorem (without proof) – Fourier sine and cosine integrals – Infinite Fourier transforms – Sine and cosine transforms – Properties– Inverse transforms – Convolution theorem (without proof) – Finite Fourier transforms.

Text Books:

1. **B. S. Grewal,** Higher Engineering Mathematics, 44th Edition, Khanna Publishers.
2. **B. V. Ramana,**Higher Engineering Mathematics, 2007 Edition, Tata Mc. Graw Hill Education.

Reference Books:

1. **Erwin Kreyszig,**Advanced Engineering Mathematics, 10th Edition, Wiley-India.
2. **Steven C. Chapra,** Applied Numerical Methods with MATLAB for Engineering and Science,Tata Mc. Graw Hill Education.
3. **M. K. Jain, S.R.K. Iyengar and R.K. Jain,** Numerical Methods for Scientific and Engineering Computation, New Age International Publications.
4. **Lawrence Turyn,**Advanced Engineering Mathematics, CRC Press.

B.Tech. (III Sem.) **23ME03- THERMODYNAMICS**

L	T	P	C
2	0	0	2

Pre-requisites: Engineering Physics

Course Objectives

- Familiarize concepts of heat, work, energy and governing rules for conversion of one form to other.
- State and illustrate the basic laws of thermodynamics. Also, to learn the concept of entropy, enthalpy, reversibility and irreversibility.
- To get conversant with properties of steam and gas mixtures.
- Provide fundamental concepts of Thermodynamic cycles.

Course Outcomes: At the end of the course students will be able to

COs	Statements
CO1	Understand the basic concepts of thermodynamics and can distinguish the forms of heat and work. **(Understanding - L2)**
CO2	Apply first of law of thermodynamics to flow and non-flow processes of thermodynamic systems **(Applying – L3)**
CO3	Apply the second law of thermodynamics to solve second law parameters of thermal systems **(Applying – L3)**
CO4	Analyze the non-reactive mixture of gases, t-s and h-s diagrams, Mollier charts, and Phase Transformations using steam tables data hand book. **(Analyzing – L4)**
CO5	Compute the performance parameters of various thermodynamic cycles. **(Applying – L3)**

UNIT – I

Basic Concepts: Introduction, system, boundary, Surrounding, Universe, Types of Systems, Macroscopic and Microscopic viewpoints, Control mass, Control volume, Concept of Continuum, Properties of system, State, Change of state, Path, Process -reversible and irreversible processes, Cycle, Quasi static Process, Thermodynamic equilibrium, Path and Point functions, Specific heat, Internal Energy, Enthalpy.

Zeroth law of Thermodynamics: Introduction, Zeroth law of thermodynamics, Measurement of temperature, Working of constant volume gas thermometer, Advantages of gas thermometer over liquid thermometers.

UNIT -II

First Law of Thermodynamics

First law analysis of closed system: Introduction, First law of thermodynamics for a closed system undergoing change of state and cycle, Representation of thermodynamic processes on p-v planes, different forms of stored energy, Forms of Energy, Mechanical and Non-mechanical forms of work transfer, pdV work and other types of work transfer.

First law analysis of open system: Introduction, Control volume, Flow work, Steady flow process, Mass and Energy balance in simple steady flow process-Steady Flow Energy Equation (SFEE), Steady Flow Engineering Devices- Nozzles, Diffusers, Turbine, Compressors, Throttling Valves, Heat Exchangers, Limitations of the First Law, PMM-I.

UNIT - III

Second Law of Thermodynamics: Introduction, Energy Reservoirs, Heat Engine, Refrigerator, Heat pump, Kelvin-Planck and Clausius Statements, Equivalence / Corollaries of Kelvin-Planck and Clausius Statements, PMM-II, Difference between reversible and irreversible process, Cause of irreversibility, Carnot cycle, Carnot Theorem, Corollary of Carnot's theorem.

Entropy: Introduction, Entropy-Principle of Entropy Increase – T-s plot, Clausius Inequality, Entropy changes for Ideal gases, Elementary treatment of Availability and Irreversibility, Maxwell Relations – Elementary Treatment of the Third Law of Thermodynamics.

UNIT – IV

Ideal gas mixtures: Equation of state of a gas, Avogadro's law, Ideal gas, perfect gas, real gas, properties of mixture of gases – Dalton's law and Amagat's law, Internal energy, enthalpy and specific heats of gas mixtures, Entropy of gas mixtures.

Pure substance: Introduction, Phases of pure substance, p-v, p-T, T-s and h-s diagrams, p-v-T Surface, Properties of steam, Dryness fraction, phase change processes, Mollier chart.

UNIT – V

Thermodynamics Cycles: Introduction**,** working of Carnot vapour cycle, working of simple Rankine cycle, Problems on Carnot vapour cycle and simple Rankine cycle, Gas power cycles - Otto, Diesel, Dual and Brayton Cycle, Refrigeration Cycles - Reversed Carnot cycle, Bell-Coleman cycle and working of vapour compression refrigeration Cycle.

Text Books:

1. P.K.Nag, Engineering Thermodynamics, 5/e, Tata McGraw Hill, 2013.
2. Claus Borgnakke Richard E. Sonntag, Fundamentals of Thermodynamics, 7/e, Wiley, 2009.

Reference Books:

1. J.B. Jones, and R.E. Dugan, Engineering Thermodynamics, 1/e, Prentice Hall, 1995.
2. Y.A.Cengel & M.A.Boles , Thermodynamics – An Engineering Approach, 7/e, McGraw Hill, 2010.
3. P.Chattopadhyay, Engineering Thermodynamics, 1/e, Oxford University Press, 2011.
4. CP Arora, Refrigeration and Air-conditioning, 4/e, McGraw Hill, 2021.

Online Learning Resources:

- https://www.edx.org/learn/thermodynamics.
- https://archive.nptel.ac.in/courses/112/106/112106310.
- https://www.youtube.com/watch?v=7NI5P4KqrAs&t=1s
- https://kp.kiit.ac.in/pdf_files/02/Study-Material_3rd-Semester_Winter_2021_Mechanical-Engg.-_Thermal-Engineering-1_Abhijit-Samant.pdf
- https://www.coursera.org/learn/thermodynamics-intro

B.Tech. (III Sem.) **23ME04- MECHANICS OF SOLIDS**

L	T	P	C
3	0	0	3

Pre-requisites: Engineering Mechanics

Course Objectives: The objectives of the course are to

- Attain a deeper understanding of the loads, stresses, and strains acting on a structure and their relations in the elastic behavior.
- Learn all the methods to analyze bars, beams, shafts and columns for normal, shear, and torsion stresses and to solve deflection problems in preparation for the design of such structural components. Students are able to analyze beams and draw correct and complete shear and bending moment diagrams for beams.

Course Outcomes: At the end of the course students will be able to

CO	Statements
CO1	Understand the concepts of basic structural members subjected to uni-axial and bi-axial loads. **(Understanding-L2)**
CO2	Construct the shear force and bending moment diagrams along the length of beam. **(Applying-L3)**
CO3	Compute the stresses of a member subjected to flexural and torsional loads. **(Applying-L3)**
CO4	Determine the transverse shear stresses and deflections of beams due to bending loads**. (Applying– L3)**
CO5	Estimate the stresses in pressure vessels and analyze the columns for buckling **(Analyzing-L4)**

UNIT– I

SIMPLE STRESSES & STRAINS : Elasticity and plasticity – Types of stresses & strains– Hooke's law – stress – strain diagram for mild steel – Working stress – Factor of safety – Lateral strain, Poisson's ratio & volumetric strain – Bars of varying section – composite bars – Thermal stresses- Complex Stresses - Stresses on an inclined plane under different uniaxial and biaxial stress conditions - Principal planes and principal stresses - Mohr's circle - Relation between elastic constants, Strain energy – Resilience – Gradual, sudden, impact and shock loadings.

UNIT –II

SHEAR FORCE AND BENDING MOMENT: Definition of beam – Types of beams – Concept of shear force and bending moment – S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, u.d.l, uniformly varying loads and combination of these loads – Point of contra flexure – Relation between S.F., B.M and rate of loading at a section of abeam.

UNIT –III

FLEXURAL STRESSES: Theory of simple bending, Derivation of bending equation, Determination of bending stresses – section modulus of rectangular, circular, I and T sections– Design of simple beam sections.

TORSION: Introduction-Derivation- Torsion of Circular shafts- Pure Shear-Transmission of power by circular shafts, Shafts in series, Shafts in parallel.

UNIT –IV

SHEAR STRESSES IN BEAMS: Derivation of formula – Shear stress distribution across various beam sections like rectangular, circular, triangular, I and T sections.

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 and Macaulay's methods – Determination of slope and deflection for cantilever and simply supported beams subjected to point loads, UDL and UVL. Mohr's theorem and Moment area method – application to simple cases.

UNIT – V

THIN AND THICK CYLINDERS: Thin seamless cylindrical shells – Derivation of formula for longitudinal and circumferential stresses – hoop, longitudinal and volumetric strains – changes in dia, and volume of thin cylinders– Thin spherical shells. Wire wound thin cylinders. Lame's equation – cylinders subjected to inside & outside pressures –compound cylinders.

COLUMNS:

Buckling and Stability, Columns with Pinned ends, Columns with other support Conditions, Limitations of Euler's Formula, Rankine's Formula.

Text Books:

1. GH Ryder, Strength of materials, Palgrave Macmillan publishers India Ltd, 1961.
2. B.C. Punmia, Strength of materials,10/e, Lakshmi publications Pvt. Ltd, New Delhi, 2018.
3. Sadhu Singh, Strength of Materials, Khanna Publishers, 2013.
4. S.Ramamrutham, Strength of Materials, Dhanpat Rai& Sons, 2011.

Reference Books:

1. Gere & Timoshenko, Mechanics of materials, 2/e, CBS publications, 2004.
2. U.C.Jindal, Strength of Materials, 2/e, Pearson Education, 2017.
3. Timoshenko, Strength of Materials Part – I& II, 3/e, CBS Publishers, 2004.
4. Andrew Pytel and Ferdinand L. Singer, Strength of Materials,4/e, Longman Publications, 1990.
5. Popov, Mechanics of Solids, 2/e, New Pearson Education, 2015.

Online Learning Resources:

- https://onlinecourses.nptel.ac.in/noc19_ce18/preview
- https://youtube/iY_ypychVNY?si=310htc4ksTQJ8Fv6
- https://www.youtube.com/watch?v=WEy939Rkd_M&t=2s
- https://www.classcentral.com/course/swayam-strength-of-materials-iitm-184204
- https://www.coursera.org/learn/mechanics-1
- https://www.edx.org/learn/engineering/massachusetts-institute-of-technology-mechanical-behavior-of-materials-part-1-linear-elastic-behavior
- https://archive.nptel.ac.in/courses/112/107/112107146/

B.Tech. (III Sem.)

23ME05- MATERIAL SCIENCE AND METALLURGY

L	T	P	C
3	0	0	3

Pre-requisites: Engineering Physics, Engineering Chemistry

Course Objective:

- Understand the crystalline structure of different metals.
- Explain the stability of phases in different alloy systems.
- Study the behavior of ferrous and non- ferrous metals and alloys and their application in different domains.
- Able to understand the effect of heat treatment, addition of alloying elements on properties of ferrous metals.
- Comprehend the properties and applications of ceramic, composites and other advanced methods.

Course Outcomes: At the end of the course students will be able to

Cos	Statements
CO1	Understand the crystalline structure of different metals **(Understanding-L2)**
CO2	Recognize the stability of phases in different alloy systems **(Remembering-L1)**.
CO3	Explain the behavior of ferrous and non-ferrous metals and alloys and their application in different domains. **(Understanding-L2)**
CO4	Study the heat treatment and age hardening process. **(Remembering-L1)**
CO5	Identify the properties and applications of ceramic, composites and other advanced methods. **(Understanding-L2)**

UNIT– I

Structure of Metals and Constitution of alloys: Crystallization of metals, Atomic Packing Factor – SC, BCC, FCC& HCP. Grain and grain boundaries, effect of grain and grain boundaries on properties of metals– determination of grain size.

Necessity of alloying, types of solid solutions, Hume Rothery's rules, intermediate alloy phases, and electron compounds.

UNIT-II

Equilibrium Diagrams: Experimental methods of construction of equilibrium diagrams, Isomorphous alloy systems, equilibrium cooling and heating of alloys, Lever rule, coring miscibility gaps, eutectic systems, peritectic reaction. Transformations in the solid state – allotropy, eutectoid, peritectoid reactions, phase rule, relationship between equilibrium diagrams and properties of alloys. Study of binary phase diagrams such as Cu-Ni, Bi-Cd and Fe-Fe3C.

UNIT–III

Ferrous metals and alloys: Structure and properties of White Cast iron, Malleable Cast iron, grey cast iron, Spheriodal graphite cast iron, Alloy cast iron. Classification of steels, structure and properties of plain carbon steels, Low alloy steels, Hadfield manganese steels, tool and die steels.

Non-ferrous Metals and Alloys: Structure and properties of Copper and its alloys, Aluminium and its alloys.

UNIT–IV

MECHANICAL WORKING: Hot working, Cold working, Strain hardening, Recovery, Recrystallisation and Grain growth. Comparison of properties of cold and hot worked parts**.**

Heat treatment of Steels: annealing, normalizing, hardening, TTT diagrams, tempering, harden ability, Jominy End Quench Test, surface - hardening methods, age hardening treatment.

UNIT– V

Ceramic and Advanced materials: Crystalline ceramics, glasses, cermets, abrasive materials, Classification of composites, manufacturing methods of fiber reinforced composites, particle reinforced composites, fiber reinforced composites, PMC, MMC, CMC and CCCs.

Text Books:

1. S.H.Avner, Introduction to Physical Metallurgy, 2/e, Tata McGraw- Hill, 1997.
2. Donald R.Askeland, Essentials of Materials science and Engineering, 4/e, CL Engineering publications, 2018.

Reference Books:

1. Dr. V.D.kodgire, Material Science and Metallurgy, 39/e, Everest Publishing House, 2017.
2. V.Raghavan, Material Science and Engineering, 5/e, Prentice Hall of India, 2004.
3. William D. Callister Jr, Materials Science and Engineering: An Introduction, 8/e, John Wiley and Sons, 2009.
4. George E.Dieter, Mechanical Metallurgy, 3/e, McGraw-Hill, 2013.
5. Yip-Wah Chung, Introduction to Material Science and Engineering, 2/e, CRC Press, 2022.
6. A V K Suryanarayana, Material Science and Metallurgy, B S Publications, 2014.
7. U. C. Jindal, Material Science and Metallurgy, 1/e, Pearson Publications, 2011.

Online Learning Resources:

- https://archive.nptel.ac.in/courses/113/106/113106032/
- https://www.edx.org/learn/mechanics/massachusetts-institute-of-technology-mechanical-behavior-of-materials-part-3-time-dependent-behavior.
- https://www.youtube.com/watch?v=9Sf278j1GTU
- https://www.coursera.org/learn/fundamentals-of-materials-science
- https://www.coursera.org/learn/material-behavior.

B.Tech. (III Sem.)

23HS01- UHV 2 – UNDERSTANDING HARMONY AND ETHICAL HUMAN CONDUCT

(Common to All branches of Engineering)

L	T	P	C
2	1	0	3

Course Objectives:

- To help the students appreciate the essential complementary 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 and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
- To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature.

Course Outcomes:

- Describe the terms like Natural Acceptance, Happiness and Prosperity (L2)
- Identify one's self, and one's surroundings (family, society nature) (L2)
- Relate human values with human relationship and human society. (L2)
- Illustrate the need for universal human values and harmonious existence (L2)
- Develop as socially and ecologically responsible engineers (L3)

Course Topics

The course has 28 lectures and 14 tutorials in 5 modules. The lectures and tutorials are of 1-hour duration. Tutorial sessions are to be used to explore and practice what has been proposed during the lecture sessions.

The Teacher's Manual provides the outline for lectures as well as practice sessions. The teacher is expected to present the issues to be discussed as propositions and encourage the students to have a dialogue.

UNIT I Introduction to Value Education (6 lectures and 3 tutorials for practicesession)

Lecture 1: Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education)
Lecture 2: Understanding Value Education
Tutorial 1: Practice Session PS1 Sharing about Oneself
Lecture 3: self-exploration as the Process for Value Education
Lecture4: Continuous Happiness and Prosperity – the Basic HumanAspirations
Tutorial 2: Practice Session PS2 Exploring Human Consciousness
Lecture 5: Happiness and Prosperity – Current Scenario
Lecture 6: Method to Fulfill the Basic Human Aspirations
Tutorial 3: Practice Session PS3 Exploring Natural Acceptance

UNIT II Harmony in the Human Being (6 lectures and 3 tutorials for practice session)

Lecture 7: Understanding Human being as the Co-existence of the self and the

body.
Lecture 8: Distinguishing between the Needs of the self and the body
Tutorial 4: Practice Session PS4 Exploring the difference of Needs of self and body.
Lecture 9: The body as an Instrument of the self
Lecture 10: Understanding Harmony in the self
Tutorial 5: Practice Session PS5 Exploring Sources of Imagination in the self
Lecture 11: Harmony of the self with the body
Lecture 12: Programme to ensure self-regulation and Health
Tutorial 6: Practice Session PS6 Exploring Harmony of self with the body

UNIT III Harmony in the Family and Society (6 lectures and 3 tutorials for practice session)

Lecture 13: Harmony in the Family – the Basic Unit of Human Interaction
Lecture 14: 'Trust' – the Foundational Value in Relationship
Tutorial 7: Practice Session PS7 Exploring the Feeling of Trust
Lecture 15: 'Respect' – as the Right Evaluation
Tutorial 8: Practice Session PS8 Exploring the Feeling of Respect
Lecture 16: Other Feelings, Justice in Human-to-Human Relationship
Lecture 17: Understanding Harmony in the Society
Lecture 18: Vision for the Universal Human Order
Tutorial 9: Practice Session PS9 Exploring Systems to fulfil Human Goal

UNIT IV Harmony in the Nature/Existence (4 lectures and 2 tutorials for practicesession)

Lecture 19: Understanding Harmony in the Nature
Lecture 20: Interconnectedness, self-regulation and Mutual Fulfilment amongthe Four Orders of Nature
Tutorial 10: Practice Session PS10 Exploring the Four Orders of Nature
Lecture 21: Realizing Existence as Co-existence at All Levels
Lecture 22: The Holistic Perception of Harmony in Existence
Tutorial 11: Practice Session PS11 Exploring Co-existence in Existence.

UNIT V Implications of the Holistic Understanding – a Look at Professional Ethics (6 lectures and 3 tutorials for practice session)

Lecture 23: Natural Acceptance of Human Values
Lecture 24: Definitiveness of (Ethical) Human Conduct
Tutorial 12: Practice Session PS12 Exploring Ethical Human Conduct
Lecture 25: A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order
Lecture 26: Competence in Professional Ethics
Tutorial 13: Practice Session PS13 Exploring Humanistic Models in Education
Lecture 27: Holistic Technologies, Production Systems and Management Models-Typical Case Studies
Lecture 28: Strategies for Transition towards Value-based Life and Profession
Tutorial 14: Practice Session PS14 Exploring Steps of Transition towards Universal Human Order

Practice Sessions for UNIT I – Introduction to Value Education
PS1 Sharing about Oneself
PS2 Exploring Human Consciousness
PS3 Exploring Natural Acceptance

Practice Sessions for UNIT II – Harmony in the Human Being
PS4 Exploring the difference of Needs of self and body
PS5 Exploring Sources of Imagination in the self
PS6 Exploring Harmony of self with the body

Practice Sessions for UNIT III – Harmony in the Family and Society
PS7 Exploring the Feeling of Trust
PS8 Exploring the Feeling of Respect
PS9 Exploring Systems to fulfil Human Goal

Practice Sessions for UNIT IV – Harmony in the Nature (Existence)
PS10 Exploring the Four Orders of Nature
PS11 Exploring Co-existence in Existence

Practice Sessions for UNIT V – Implications of the Holistic Understanding – a Look at Professional Ethics
PS12 Exploring Ethical Human Conduct
PS13 Exploring Humanistic Models in Education
PS14 Exploring Steps of Transition towards Universal Human Order

READINGS:

Textbook and Teachers Manual

a. **The Textbook**
   R R Gaur, R Asthana, G P Bagaria, *A Foundation Course in Human Values and Professional Ethics*, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1
b. **The Teacher's Manual**
   R R Gaur, R Asthana, G P Bagaria,*Teachers' Manual for A Foundation Course in Human Values and Professional Ethics,* 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2

Reference Books

1. *JeevanVidya: EkParichaya,* A Nagaraj, JeevanVidyaPrakashan, Amarkantak, 1999.
2. *Human Values*, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. *The Story of Stuff* (Book).
4. *The Story of My Experiments with Truth* - by Mohandas Karamchand Gandhi
5. *Small is Beautiful* - E. F Schumacher.
6. *Slow is Beautifu*l - Cecile Andrews
7. *Economy of Permanence* - J C Kumarappa
8. *Bharat Mein Angreji Raj* – PanditSunderlal
9. *Rediscovering India* - by Dharampal
10. *Hind Swaraj or Indian Home Rule* - by Mohandas K. Gandhi

11. *India Wins Freedom* - Maulana Abdul Kalam Azad
12. *Vivekananda* - Romain Rolland (English)
13. *Gandhi* - Romain Rolland (English)

Mode of Conduct:

Lecture hours are to be used for interactive discussion, placing the proposals about the topicsat hand and motivating students to reflect, explore and verify them.

Tutorial hours are to be used for practice sessions.

While analyzing and discussing the topic, the faculty mentor's role is in pointing to essential elements to help in sorting them out from the surface elements. In other words, help the students explore the important or critical elements.

In the discussions, particularly during practice sessions (tutorials), the mentor encourages the student to connect with one's own self and do self-observation, self-reflection and self-exploration.

Scenarios may be used to initiate discussion. The student is encouraged to take up "ordinary" situations rather than" extra-ordinary" situations. Such observations and their analyses are shared and discussed with other students and faculty mentor, in a group sitting.

Tutorials (experiments or practical) are important for the course. The difference is that the laboratory is everyday life, and practical are how you behave and work in real life. Depending on the nature of topics, worksheets, home assignment and/or activity are included. The practice sessions (tutorials) would also provide support to a student in performing actions commensurate to his/her beliefs. It is intended that this would lead to development of commitment, namely behaving and working based on basic human values.

It is recommended that this content be placed before the student as it is, in the form of a basic foundation course, without including anything else or excluding any part of this content. Additional content may be offered in separate, higher courses. This course is to be taught by faculty from every teaching department, not exclusively by any one department.

Teacher preparation with a minimum exposure to at least one 8-day Faculty Development Program on Universal Human Values is deemed essential.

Online Resources:

1. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%201-Introduction%20to%20Value%20Education.pdf
2. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%202-Harmony%20in%20the%20Human%20Being.pdf
3. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%203-Harmony%20in%20the%20Family.pdf
4. https://fdp-si.aicte-india.org/UHV%201%20Teaching%20Material/D3-S2%20Respect%20July%2023.pdf
5. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%205-Harmony%20in%20the%20Nature%20and%20Existence.pdf
6. https://fdp-si.aicte-india.org/download/FDPTeachingMaterial/3-days%20FDP-SI%20UHV%20Teaching%20Material/Day%203%20Handouts/UHV%203D%20D3-S2A%20Und%20Nature-Existence.pdf
7. https://fdp-si.aicte-

india.org/UHV%20II%20Teaching%20Material/UHV%20II%20Lecture%2023-25%20Ethics%20v1.pdf

8. https://www.studocu.com/in/document/kiet-group-of-institutions/universal-human-values/chapter-5-holistic-understanding-of-harmony-on-professional-ethics/62490385
9. https://onlinecourses.swayam2.ac.in/aic22_ge23/preview

B.Tech. (III Sem.)	23MC01- ENVIRONMENTAL SCIENCE (Common to All branches of Engineering)	L	T	P	C
		2	0	0	--

Pre-requisites: Nil

Course Objectives: The objective of this course is to understand Environmental issues like natural resource depletion, pollution, interaction between human and ecosystems and their role in the food web in the natural world, importance of global biodiversity and significance of environmental law in India.

Course Outcomes: In this course the student will learn about

CO1: The necessity of resources, their exploitation and sustainable management **(Understand – L2)**

CO2: The interactions of human and ecosystems and their role in the food web in the natural world and the global biodiversity, threats to biodiversity and its conservation. **(Understand – L2)**

CO3: Environmental problems like pollution, disasters and possible solutions. **(Remember – L1)**

CO4: The importance of environmental decision making in organizations through understanding the environmental law and environmental audits. **(Remember – L1)**

CO5: Environmental issues like over population, human health etc related to local, regional and global levels. **(Understand – L2)**

UNIT – I

Multidisciplinary Nature of Environmental Studies: – Definition, Scope and Importance – Need for Public Awareness.

Natural Resources : Renewable and non-renewable resources – Natural resources and associated problems – Forest resources – Use and over – exploitation, deforestation, case studies – Timber extraction – Mining, dams and other effects on forest and tribal people – Water resources – Use and over utilization of surface and ground water – Floods, drought, conflicts over water, dams – benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. – Energy resources:

UNIT-II

Ecosystems: Concept of an ecosystem. – Structure and function of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Ecological succession – Food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the following ecosystem:

a. Forest ecosystem.
b. Grassland ecosystem
c. Desert ecosystem
d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Biodiversity and Its Conservation : Introduction and Definition: genetic, speciesand ecosystem diversity – Bio-geographical classification of India – Value of biodiversity: consumptive use, Productive use, social, ethical, aesthetic and option values – Biodiversity at global, National and local levels – India as a mega-diversity nation – Hot-sports of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – Endangered and endemic species of India – Conservation of biodiversity: In-situ and

Ex-situ conservation of biodiversity.

UNIT – III

Environmental Pollution: Definition, Cause, effects and control measures of:

a. Air Pollution.
b. Water pollution
c. Soil pollution
d. Marine pollution
e. Noise pollution
f. Thermal pollution
g. Nuclear hazards

Solid Waste Management: Causes, effects and control measures of urban and industrial wastes – Role of an individual in prevention of pollution – Pollution case studies – Disaster management: floods, earthquake, cyclone and landslides.

UNIT – IV

Social Issues and the Environment: From Unsustainable to Sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, watershed management – Resettlement and rehabilitation of people; its problems and concerns. Case studies – Environmental ethics: Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies – Wasteland reclamation. – Consumerism and waste products. – Environment Protection Act. – Air (Prevention and Control of Pollution) Act. – Water (Prevention and control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – Issues involved in enforcement of environmental legislation – Public awareness.

UNIT – V

Human Population And The Environment: Population growth, variation among nations. Population explosion – Family Welfare Programmes. – Environment and human health – Human Rights – Value Education – HIV/AIDS – Women and Child Welfare – Role of information Technology in Environment and human health – Case studies.

Field Work: Visit to a local area to document environmental assets River/forest grassland/hill/mountain – Visit to a local polluted site-Urban/Rural/Industrial/Agricultural Study of common plants, insects, and birds – river, hill slopes, etc.

Textbooks:

1. Erach Bharucha, Text book of Environmental Studies for Undergraduate Courses, Universities Press (India) Private Limited, 2019.
2. Palaniswamy, Environmental Studies, 2/e, Pearson education, 2014.
3. S.Azeem Unnisa, Environmental Studies, Academic Publishing Company, 2021.
4. K.Raghavan Nambiar, "Text book of Environmental Studies for Undergraduate Courses as per UGC model syllabus", SciTech Publications (India), Pvt. Ltd, 2010.

Reference Books:

1. Deeksha Dave and E.Sai Baba Reddy, Textbook of Environmental Science, 2/e, Cengage Publications, 2012.

2. M.Anji Reddy, "Textbook of Environmental Sciences and Technology", BS Publication, 2014.
3. J.P. Sharma, Comprehensive Environmental studies, Laxmi publications, 2006.
4. J. Glynn Henry and Gary W. Heinke, Environmental Sciences and Engineering, Prentice Hall of India Private limited, 1988.
5. G.R. Chatwal, A Text Book of Environmental Studies, Himalaya Publishing House, 2018.
6. Gilbert M. Masters and Wendell P. Ela, Introduction to Environmental Engineering and Science, 1/e, Prentice Hall of India Private limited, 1991.

Online Learning Resources:

- https://onlinecourses.nptel.ac.in/noc23_hs155/preview
- https://www.edx.org/learn/environmental-science/rice-university-ap-r-environmental-science-part-3-pollution-and-resources?index=product&objectID=course-3a6da9f2-d84c-4773-8388 1b2f8f6a75f2&webview=false&campaign=AP%C2%AE+Environmental+Science++Part+3%3A+Pollution+and+Resources&source=edX&product_category=course&placement_url=https%3A%2F%2Fwww.edx.org%2Flearn%2Fenvironmental-science
- http://ecoursesonline.iasri.res.in/Courses/Environmental%20Science-I/Data%20Files/pdf/lec07.pdf
- https:// www.youtube.com/watch?v=5QxxaVfgQ3k

B.Tech. (III Sem.)

23ME53- MECHANICS OF SOLIDS & MATERIALS SCIENCE LAB

L	T	P	C
0	0	3	1.5

Pre-requisites: Mechanics of Solids, Material Science and Metallurgy

Course Objective:

- Evaluate the values of yield stress, ultimate stress and bending stress of the given specimen under tension test and bending test
- Conduct the torsion test to determine the modulus of rigidity of given specimen.
- Justify the Rockwell hardness test over with Brinell hardness and measure the hardness of the given specimen.
- Examine the stiffness of the open coil and closed coil spring and grade them.
- Analyze the microstructure and characteristics of ferrous and non ferrous alloy specimens.

Course Outcomes: At the end of the course students will be able to

CO	Statements
CO1	Estimate the behaviour of various materials under different loading. **(Understanding L2)**
CO2	Calculate the hardness of different materials. **(Applying – L3)**
CO3	Evaluate the mechanical properties of materials by conducting various tests. **(Applying-L3)**
CO4	Identify the material by observing the microstructure. **(Applying-L3)**
CO5	Evaluate hardness of treated and untreated steels. **(Applying-L3)**

NOTE: Any 6 experiments from each section A and B.

A) MECHANICS OF SOLIDS LAB:

1. Tensile test
2. Bending test on
   a) Simply supported beam
   b) Cantilever beam
3. Torsion test
4. Hardness test
   a) Brinell's hardness test
   b) Rockwell hardness test
   c) Vickers hardness test
5. Test on springs
6. Impact test
   a) Charpy test
   b) Izod test
7. Shear test

B) MATERIAL SCIENCE LAB:

1. Preparation and study of the Microstructure of pure metals.
2. Preparation and study of the Microstructure of Mild steel, medium carbon steels, andHigh carbon steels.
3. Study of the Microstructures of Cast Irons.

4. Study of the Microstructures of Non-Ferrous alloys.
5. Study of the Microstructures of Heat treated steels.
6. Hardenability of steels by Jominy End Quench Test.

Virtual lab:

- To investigate the principal stresses σa and σb at any given point of a structural element or machine component when it is in a state of plane stress. (https://virtual-labs.github.io/exp-rockwell-hardness-experiment-iiith/objective.html)
- To find the impact resistance of mild steel and cast iron.(https://sm-nitk.vlabs.ac.in/exp/izod-impact-test).
- To find the impact resistance of mild steel.(https://sm-nitk.vlabs.ac.in/exp/charpy-impact-test/index.html)
- To find the Rockwell hardness number of mild steel, cast iron, brass, aluminum and spring steel etc. (https://sm-nitk.vlabs.ac.in/exp/rockwell-hardness-test)
- To determine the indentation hardness of mild steel, brass, aluminum etc. using Vickers hardness testing machine. (https://sm-nitk.vlabs.ac.in/exp/vickers-hardness-test).

B.Tech. (III Sem.)	23ME54- COMPUTER-AIDED MACHINE DRAWING	L	T	P	C
		0	0	3	1.5

Pre-requisites: Engineering Graphics

Course Objectives

- Introduce conventional representations of material and machine components.
- Train to use software for 2D and 3D modeling.
- Familiarize with thread profiles, riveted, welded and key joints.
- Teach solid modeling of machine parts and their sections.
- Explain creation of 2D and 3D assembly drawings and familiarize with limits, fits, and tolerances in mating components.

Course Outcomes: At the end of the course students will be able to

COs	Statements
CO1	Demonstrate the conventional representations of materials and machine components. **(Understanding-L2)**
CO2	Model riveted, welded and key joints using CAD system. **(Applying-L3)**
CO3	Create solid models and sectional views of machine components. **(Applying-L3)**
CO4	Assemble the solid models of machine parts. **(Evaluating-L5)**
CO5	Generate part drawings from assembly. **(Evaluating-L5)**

The following are to be done by any 2D software package

Conventional representation of materials and components:

Detachable joints: Drawing of thread profiles, hexagonal and square-headed bolts and nuts, bolted joint with washer and locknut, stud joint, screw joint and foundation bolts.

Riveted joints: Drawing of rivet, lap joint, butt joint with single strap, single riveted, double riveted double strap joints.

Welded joints: Lap joint and T joint with fillet, butt joint with conventions.

Keys: Taper key, sunk taper key, round key, saddle key, feather key, woodruff key.

Couplings: rigid – Muff, flange; flexible – bushed pin-type flange coupling, universal coupling, Oldham's' coupling.

The following exercises are to be done by any 3D software package:

Sectional views:

Creating solid models of complex machine parts and sectional views.

Assembly drawings:(Any four of the following using solid model software)

Lathe tool post, tool head of shaping machine, tail-stock, machine vice, gate valve, carburetor, piston, connecting rod, eccentric, screw jack, plumber block, axle bearing, pipe vice, clamping device, Geneva cam, universal coupling.

Production drawing:

Representation of limits, fits and tolerances for mating parts. Use any four parts of above assembly drawings and prepare manufacturing drawing with dimensional and geometric

tolerances.

Textbooks:

1. Machine Drawing by K.L.Narayana, P.Kannaiah and K.Venkat Reddy, New Age International Publishers, 3/e, 2014
2. Machine drawing by N.Sideshwar, P. Kannaiah, V.V.S.Sastry, TMH Publishers. 2014.

Reference Books:

1. Cecil Jensen, Jay Helsel and Donald D.Voisinet, Computer Aided Engineering Drawing, Tata McGraw-Hill, NY, 2000.
2. James Barclay, Brain Griffiths, Engineering Drawing for Manufacture, KoganPage Science, 2003.
3. N.D.Bhatt, Machine Drawing, Charotar Publishers, 50/e, 2014.

Online Learning Resources:

- https://eeedocs.wordpress.com/wp-content/uploads/2014/02/machinedrawing.pdf
- https://archive.nptel.ac.in/courses/112/105/112105294/
- https://www.edx.org/learn/engineering/dassault-systemes-solidworks-solidworks-cad-fundamentals?index=product&queryID=c90b35a82a6ef58b0d6f89679c63f6a1&position=2&linked_from=autocomplete&c=autocomplete
- https://www.youtube.com/watch?v=0bQkS3_3Fq4

B.Tech. (III Sem.)

23CS57- PYTHON PROGRAMMING LAB

L	T	P	C
0	0	2	1

Pre-requisites: Introduction to Programming

Course Objectives: The main objectives of the course are to

1. **Fundamental Understanding:** Develop a solid foundation in Python programming, covering essential syntax, semantics, and constructs.
2. **Data Manipulation:** Equip students with skills to handle and manipulate data using Python libraries like Pandas and NumPy.
3. **Problem-Solving:** Enhance problem-solving abilities by implementing various algorithms and data structures in Python.
4. **Software Development:** Foster software development skills, including version control, package management, and project documentation.
5. **Advanced Techniques:** Introduce advanced Python topics such as web scraping, API interaction, and database management.

Course Outcomes: After learning the contents of this course, the student must be able to

CO1: Understand Python programming Constructs, Syntax, and Semantics. **(Understand-L2)**

CO2: Develop Applications using Python Libraries. **(Apply-L3)**

CO3: Implement Different Data Structures, Web Scrapping and Database programming using Python. **(Apply-L3)**

CO4: Improve individual / teamwork skills, communication & report writing skills with ethical values

LIST OF EXPERIMENTS

Experiment 1: Introduction to Python

Objective: Install Python and set up the development environment.

Tasks:

- Install Python and an IDE (e.g., PyCharm, VSCode, or Jupyter Notebook).
- Write and run a simple "Hello, World!" program.
- Understand and demonstrate basic Python syntax and semantics.

Experiment 2: Basic Python Programming

Objective: Learn basic programming constructs in Python.

Tasks:

- Create programs using variables, data types, and operators.
- Implement basic input and output functions.
- Write programs using control structures (if statements, for loops, while loops).

Experiment 3: Functions and Modules

Objective: Understand functions and module usage in Python.

Tasks:

- Define and call functions with different types of arguments and return values.
- Explore and use built-in Python modules.
- Write a script that imports and utilizes at least two different standard library modules.

Experiment 4: Lists and Tuples

Objective: Work with Python lists and tuples.

Tasks:

- Create, modify, and iterate over lists and tuples.
- Perform list comprehensions to create new lists.
- Demonstrate the immutability of tuples.

Experiment 5: Dictionaries and Sets

Objective: Explore dictionaries and sets in Python.

Tasks:

- Create and manipulate dictionaries.
- Use dictionary comprehension.
- Create and perform operations on sets.

Experiment 6: Strings and File I/O

Objective: Manipulate strings and perform file I/O operations.

Tasks:

- Demonstrate various string methods.
- Write programs to read from and write to text files.
- Work with different file formats, including CSV and JSON.

Experiment 7: Error Handling and Exceptions

Objective: Implement error handling in Python programs.

Tasks:

- Write programs using try, except, else, and finally blocks.
- Handle specific exceptions.
- Create and raise custom exceptions.

Experiment 8: Object-Oriented Programming (OOP)

Objective: Understand and implement OOP concepts in Python.

Tasks:

- Define classes and create objects.
- Demonstrate inheritance and polymorphism.
- Use class and instance variables in programs.

Experiment 9: Libraries and Packages

Objective: Utilize third-party libraries and create Python packages.

Tasks:

- Install and use libraries like NumPy and Pandas.
- Create a simple Python package and distribute it.
- Work with virtual environments to manage dependencies.

Experiment 10: Working with Data

Objective: Perform data manipulation and visualization.

Tasks:

- Use Pandas to load, manipulate, and analyze datasets.
- Create visualizations using Matplotlib and Seaborn.
- Conduct basic data analysis tasks and summarize findings.

Experiment 11: Web Scraping and APIs

Objective: Extract data from the web and interact with APIs.

Tasks:

- Access and parse data from RESTful APIs.
- Process and analyze JSON data from APIs.

Experiment 12: Databases

Objective: Work with databases in Python.

Tasks:

- Connect to a database using SQLite and SQLAlchemy.
- Perform CRUD operations on the database.
- Write queries to manage and retrieve data.

Online Resources

1. https://www.udemy.com/course/python-the-complete-python-developer-course/?matchtype=e&msclkid=0584dfb54dc715f39c0bb9aaf74033be&utm_campaign=BG Python_v.PROF_la.EN_cc.INDIA_ti.7380&utm_content=deal4584&utm_medium=udemyads&utm_source=bing&utm_term=_._ag_1220458320107116_._ad_._kw_Python+language_._de_c_._dm_._pl_._ti_kwd-76278984197882%3Aloc-90_._li_116074_._pd._&couponCode=IND21PM
2. https://www.w3schools.com/python/python_intro.asp
3. https://www.youtube.com/watch?v=eWRfhZUzrAc
4. https://onlinecourses.nptel.ac.in/noc20_cs83/preview
5. https://www.edx.org/learn/python
6. Virtual Labs - https://python-iitk.vlabs.ac.in/
7. Virtual Labs - https://virtual-labs.github.io/exp-arithmetic-operations-iitk/
8. Virtual Labs - https://cse02-iiith.vlabs.ac.in/ https://mlritm.ac.in/assets/cse/cse_lab_manuals/R20_cse_manuals/Python%20Lab%20Manua l.pdf

B.Tech. (III Sem.) **23ECS1- EMBEDDED SYSTEMS & IoT**

L	T	P	C
0	1	2	2

Pre-requisites: Nil

Course Objectives:

- To comprehend Microcontroller-Transducers Interface techniques
- To establish Serial Communication link with Arduino
- To analyze basics of SPI communication and interfacing techniques of Stepper Motor, Accelerometer with Arduino.
- To introduce the Raspberry PI platform, that is widely used in IoT applications
- To introduce the implementation of distance sensor on IoT devices.

Course Outcomes: After competition of this course, the student will be able to

CO1 : Comprehend Microcontroller-Transducers Interface techniques. **(Understand – L2)**

CO2 : Identify the programming concepts of IOT. **(Apply – L3)**

CO3: Develop real time applications using Internet of Things. **(Apply – L3)**

CO4 : Demonstrate the integration of sensors with IOT.. **(Apply – L3)**

CO5 : Adapt effective Communication, presentation and report writing skills. **(Apply – L3)**

Embedded Systems Experiments: (Any 5 experiments from the following)

1. Measure Analog signal from Temperature Sensor.
2. Generate PWM output.
3. Drive single character generation on Hyper Terminal.
4. Drive a given string on Hyper Terminal.
5. Full duplex Link establishment using Hyper terminal.
6. Drive a given value on a 8 bit DAC consisting of SPI.
7. Drive Stepper motor using Analog GPIOs.
8. Drive Accelerometer and Display the readings on Hyper Terminal.

COMPONENTS/ BOARDS: 1. Arduino Duemilanove Board 2. Arduino Software IDE.

Text Books:

1. Embedded Systems Architecture- By Tammy Noergaard, Elsevier Publications, 2013.
2. Embedded Systems-By Shibu. K.V-Tata McGraw Hill Education Private Limited, 2013.
3. Embedded System Design, Frank Vahid, Tony Givargis, John Wiley Publications, 2013.
4. Embedded Systems-Lyla B.Das-Pearson Publications,2013.

Internet of Things Experiments: (Any 5 experiments from the following)

1. Getting started with Raspberry Pi, Install Raspian on your SD card.
2. Python-based IDE (integrated development environments) for the Raspberry Pi and how to trace and debug Python code on the device.
3. Using Raspberry pi a. Calculate the distance using distance sensor. b. Basic LED functionality.
4. Raspberry Pi interact with online services through the use of public APIs and SDKs.
5. Study and Install IDE of Arduino and different types of Arduino.

6. Study and Implement Zigbee Protocol using Arduino / Raspberry Pi.
7. Calculate the distance using distance sensor Using Arduino.
8. Basic LED functionality Using Arduino.
9. Calculate temperature using temperature sensor Using Arduino.
10. Calculate the distance using distance sensor Using Node MCU.
11. Basic LED functionality Using Node MCU.

Text Books:

1. Arsheep Bahga &Vijay Madisetti, Internet of Things - A Hands-on Approach, 1/e, Orient Blackswan Private Limited - New Delhi, 2015.
2. Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015.
3. Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014,.

Online Learning Sources

1. https://onlinecourses.nptel.ac.in/noc21_cs17/preview
2. https://onlinecourses.nptel.ac.in/noc20_ee98/preview
3. https://archive.nptel.ac.in/courses/108/105/108105057/
4. https://www.edx.org/learn/embedded-systems/the-university-of-texas-at-austin-embedded-systems-shape-the-world_microcontroller__input_output?index=product&objectID=course-785cf551-7f66-4350-b736-64a93427b4db&webview=false&campaign=Embedded+Systems+-+Shape+The+World%3A+Microcontroller+Input%2FOutput&source=edX&product_category=course&placement_url=https%3A%2F%2Fwww.edx.org%2Flearn%2Fembedded-systems
5. https://www.edx.org/learn/iot-internet-of-things/universitat-politecnica-de-valencia-introduction-to-the-internet-of-things?index=product&queryID=e1322674dcb3d246be981d0669265399&position=4&linked_from=autocomplete&c=autocomplete
6. https://www.edx.org/learn/iot-internet-of-things/curtin-university-iot-sensors-and-devices?index=product&queryID=94ff5bcb80b8e4f427a0985bb2a5e07f&position=3&results_level=first-level-results&term=IOT&objectID=course-967eee29-87e8-4f2d-9257a1b38ec07e85&campaign=IoT+Sensors+and+Devices&source=edX&product_category=course&placement_url=https%3A%2F%2Fwww.edx.org%2Fsearch
7. Virtual Labs - http://vlabs.iitkgp.ac.in/rtes/
8. Virtual Labs - https://cse02-iiith.vlabs.ac.in/
9. Virtual Labs - https://iotvirtuallab.github.io/vlab/Experiments/index.html

B.Tech. (IV Sem.)

23FE13- COMPLEX VARIABLES, PROBABILITY AND STATISTICS

L	T	P	C
3	0	0	3

Pre-requisites: Nil

Course Objectives:

- To familiarize the complex variables.
- To familiarize the students with the foundations of probability and statistical methods.
- To equip the students to solve application problems in their disciplines.

Course Outcomes: Upon successful completion of the course, the students will be able to

CO1: Apply Cauchy-Riemann equations to complex functions in order to determine whether a given continuous function is analytic. (L3)

CO2: Make use of Cauchy residue theorem to evaluate certain integrals (L3)

CO3: Infer the statistical inferential methods based on small and large sample tests (L4)

CO4: Find the differentiation and integration of complex functions used in engineering problems (L3)

CO5: Design the components of a classical hypothesis test. (L4)

UNIT– I: Functions of a complex variable and Complex integration:

Introduction–Continuity –Differentiability–Analyticity –Cauchy-Riemann equations in Cartesian and polar coordinates–Harmonic and conjugate harmonic functions– Milne–Thompson method.

Complex integration: Line integral –Cauchy's integral theorem –Cauchy's integral formula– Generalized integral formula (all without proofs) and problems on above theorems.

UNIT – II: Series expansions and Residue Theorem:

Radius of convergence – Expansion in Taylor's series, Maclaurin's series and Laurentseries.

Types of Singularities: Isolated – Essential –Pole of order m– Residues – Residue theorem (without proof) – Evaluation of real integral of tilt types $\int_{-\infty}^{\infty} f(x)dx$ and $\int_{c}^{c+2\pi} f(\sin\theta,\cos\theta)d\theta$

UNIT–III: Probability and Distributions:

Review of probability and Baye's theorem – Random variables – Discrete and Continuous random variables – Distribution functions – Probability mass function, Probability density function and Cumulative distribution functions – Mathematical Expectation and Variance – Binomial, Poisson, Uniform and Normal distributions.

UNIT–IV: Sampling Theory:

Introduction – Population and Samples – Sampling distribution of Means and Variance (definition only)–Central limit theorem (without proof)–Representation of the normal theory distributions– Introduction to t, χ^2 and F-distributions- point and interval estimations – maximum error of estimate.

UNIT–V: Tests of Hypothesis:

Introduction – Hypothesis – Null and Alternative Hypothesis – Type I and Type II errors – Level of significance – One tail and two-tail tests – Tests concerning one mean and two means (Large and Small samples)–Tests on proportions.

Text Books:

1. B.S. Grewal, Higher Engineering Mathematics, 44/e, Khanna Publishers.
2. Miller and Freund's, Probability and Statistics for Engineers,7/e,Pearson,2008.

ReferenceBooks:

1. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 9/e, Mc-Graw Hill,2013.
2. S.C.Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics,11/e, Sultan Chand &Sons Publications,2012.
3. Jay l. Devore, Probability and Statistics for Engineering and the Sciences,8/e, Cengage.
4. ShronL. Myers, KeyingYe, Ronald E Walpole, Probability and Statistics Engineers and the Scientists,8/e,Pearson 2007.
5. Sheldon, M.Ross, Introduction to probability and statistics Engineers and the Scientists, 4/e, Academic Foundation,2011.

Online Learning Sources:

- https://archive.nptel.ac.in/courses/111/103/111103070/
- https://biet.ac.in/pdfs/PROBABILITY%20AND%20STATISTICS%20&%20COMPLEX%20VARIABLES.pdf
- https://archive.nptel.ac.in/courses/111/105/111105090/
- http://acl.digimat.in/nptel/courses/video/111102160/L23.html
- https://onlinecourses.nptel.ac.in/noc21_ma57/preview

B.Tech. (IV Sem.)

23ME06- MANUFACTURING PROCESSES

L	T	P	C
3	0	0	3

Pre-requisites: Material Science and Metallurgy

Course Objective: The objectives of the course are to

- Understand the working principle of different metal casting processes and gating system.
- Classify the welding processes, working of different types of welding processes and welding defects.
- Recognize the nature of plastic deformation, cold and hot working process, working of arolling mill and types, extrusion processes.
- Understand the principles of forging, tools and dies, working of forging processes.
- Explain about the powder metallurgy processes.

Course Outcomes: At the end of the course students will be able to

COs	Statements
CO1	Recognize the patterns and core boxes for metal casting processes. **(Remembering -L1)**
CO2	Understand the different welding processes. **(Understanding-L2)**
CO3	Explain the different types of bulk forming processes. **(Understanding-L2)**
CO4	Understand sheet metal forming processes. **(Understanding-L2)**
CO5	Differentiate different types of powder metallurgy processes. **(Understanding-L2)**

UNIT– I

Casting: Steps involved in making a casting – Advantage of casting and its applications. Patterns and Pattern making – Types of patterns – Materials used for patterns, pattern allowances and their construction, Molding, different types of cores, Principles of Gating, Risers, casting design considerations. Basic principles and applications of special casting processes - Centrifugal casting, Die casting, Investment casting and shell molding.

UNIT–II

Welding: Classification of welding processes, types of welded joints and their characteristics, Gas welding, Different types of flames and uses, Oxy – Acetylene Gas cutting. Basic principles of Arc welding, Manual metal arc welding, submerged arc welding, TIG & MIG welding, Electro–slag welding.

Resistance welding, Friction welding, Friction stir welding, Forge welding, Explosive welding; Thermit welding, Plasma Arc welding, Laser welding, electron beam welding, Soldering &Brazing. Heat affected zones in welding; pre & post heating.

UNIT–III

Bulk Forming: Plastic deformation in metals and alloys-recovery, recrystallization and grain growth. Hot working and Cold working-Strain hardening and Annealing. Bulk forming processes: Forging-Types of Forging, forging defects and remedies; Rolling – fundamentals, types of rolling mills and products, Forces in rolling and power requirements. Extrusion and its characteristics. Types of extrusion, Impact extrusion, Hydrostatic extrusion; Wire drawing and Tube drawing.

UNIT– IV

Sheet metal forming-Blanking and piercing, Forces and power requirement in these operations, Deep drawing, Stretch forming, Bending, Spring back and its remedies, Coining, Spinning, Types of presses and press tools.

High energy rate forming processes: Principles of explosive forming, electromagnetic forming, Electro hydraulic forming, rubber pad forming, advantages and limitations.

UNIT -V

Powder Metallurgy: Basic processes- Methods of producing metal powders- milling atomization-Granulation-Reduction-Electrolytic Deposition. Compacting methods – Sintering - Methods of manufacturing sintered parts. Secondary operations, Applications of powder metallurgical products.

Text books:

1. Kalpakjain S and Steven R Schmid, Manufacturing Processes for Engineering Materials, 5/e, Pearson Publications, 2007.
2. P.N. Rao, Manufacturing Technology -Vol I, 5/e, McGraw Hill Education, 2018.

Reference Books:

1. A.Ghosh & A.K.Malik, Manufacturing Science, East West Press Pvt. Ltd, 2010.
2. Lindberg and Roy, Processes and materials of manufacture, 4/e, Prentice Hall India Learning Private Limited, 1990.
3. R.K. Jain, Production Technology, Khanna Publishers, 2022.
4. Sharma P.C., A Text book of Production Technology, 8/e, S Chand Publishing, 2014.
5. H.S. Shaun, Manufacturing Processes, 1/e, Pearson Publishers, 2012.
6. WAJ Chapman , Workshop Technology, 5/e, CBS Publishers & Distributors Pvt. Ltd, 2001.
7. Hindustan Machine Tools, Production Technology, Tata McGraw Hill Publishers, 2017.
8. Ian Gibson, David W Rosen, Brent Stucker., Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, 2/e, Springer, 2015.

Online Learning Resources:

- https://www.edx.org/learn/manufacturing/massachusetts-institute-of-technology-fundamentals-of-manufacturing-processes
- https://onlinecourses.nptel.ac.in/noc21_me81/preview
- www.coursera.org/learn/introduction-to-additive-manufacturing-processessera
- https://archive.nptel.ac.in/courses/112/103/112103263/
- https://elearn.nptel.ac.in/shop/nptel/principles-of-metal-forming-technology/?v=c86ee0d9d7ed

B.Tech. (IV Sem.)

23ME07 - FLUID MECHANICS & HYDRAULIC MACHINES

L	T	P	C
3	0	0	3

Pre-requisites: Engineering Physics

Course Objective: The students completing this course are expected to

- Understand the properties of fluids, manometry, hydrostatic forces acting on different surfaces
- Understand the kinematic and dynamic behavior through various laws of fluids like continuity, Euler's, Bernoulli's equations, energy and momentum equations.
- Understand the theory of boundary layer, working and performance characteristics of various hydraulic machines like pumps and turbines.

Course Outcomes: At the end of the course students will be able to

COs	Statements
CO1	Understand the fundamentals of fluid mechanics and summarize the properties of fluid flows. **(Understanding L2)**
CO2	Calculate the properties of fluids in static and dynamic conditions. **(Applying-L3)**
CO3	Apply the boundary layer theory to determine flow separation in fluid flow systems. **(Applying-L3)**
CO4	Solve the hydrodynamic forces of jet on vanes in different positions and turbine performance parameters. **(Applying-L3)**
CO5	Distinguishes the performance parameters of turbines and pumps. **(Understanding L2)**

UNIT-I

Fluid statics: Dimensions and units: physical properties of fluids - specific gravity, viscosity and its significance, surface tension, capillarity, vapor pressure. Atmospheric, gauge and vacuum pressure, Measurement of pressure – Manometers - Piezometer, U-tube, inverted and differential manometers. Pascal's & hydrostatic laws.

Buoyancy and floatation: Meta center, stability of floating body. Submerged bodies. Calculation of metacenter height. Stability analysis and applications.

UNIT-II

Fluid Kinematics: Introduction, flow types. Equation of continuity for one dimensional flow, circulation and vorticity, Stream line, path line and streak lines and stream tube. Stream function and velocity potential function, differences and relation between them.

Fluid dynamics: surface and body forces –Euler's and Bernoulli's equations for flow along a streamline, momentum equation and its applications, force on pipe bend.

Closed conduit flow: Reynold's experiment- Darcy Weisbach equation- Minor losses in pipes- pipes in series and pipes in parallel total energy line hydraulic gradient line.

UNIT-III

Boundary Layer Theory: Introduction, momentum integral equation, displacement, momentum and energy thickness, separation of boundary layer, control of flow separation, Stream lined body,

Bluff body and its applications, basic concepts of velocity profiles.
Dimensional Analysis: Dimensions and Units, Dimensional Homogeneity, Non dimensionalization of equations, Method of repeating variables and Buckingham Pi Theorem.

UNIT-IV

Basics of turbo machinery: hydrodynamic force of jets on stationary and moving flat, inclined, and curved vanes, jet striking centrally and at tip, velocity diagrams, work done and efficiency, flow over radial vanes.
Hydraulic Turbines: classification of turbines, impulse and reaction turbines, Pelton wheel, Francis turbine and Kaplan turbine-working proportions, work done, efficiencies, hydraulic design –draft tube-theory-functions and efficiency.

UNIT-V

Performance of hydraulic turbines: Geometric similarity, Unit and specific quantities, characteristic curves, governing of turbines, selection of type of turbine, cavitation.
Centrifugal pumps: classification, working, work done – manometric head- losses and efficiencies-specific speed- pumps in series and parallel-performance characteristic curves, cavitation & NPSH. **Reciprocating pumps:** Working, Discharge, slip, indicator diagrams.

Text Books:

1. Y.A. Cengel, J.M.Cimbala, Fluid Mechanics, Fundamentals and Applications,6/e,McGraw Hill Publications, 2019.
2. Dixon, Fluid Mechanics and Thermodynamics of Turbo machinery, 7/e, Elsevier Publishers, 2014.

Reference Books:

1. P N Modi and S M Seth, Hydraulics & Fluid Mechanics including Hydraulics Machines, Standard Book House, 2017.
2. RK Bansal, Fluid Mechanics and Hydraulic Machines, 10/e, Laxmi Publications (P)Ltd, 2019.
3. Rajput, Fluid Mechanics and Hydraulic Machines, S Chand & Company, 2016.
4. D.S. Kumar, Fluid Mechanics and Fluid Power Engineering, S K Kataria &Sons, 2013.
5. D. Rama Durgaiah, Fluid Mechanics and Machinery,1/e, New Age International, 2002.

Online Learning Resources:

- https://archive.nptel.ac.in/courses/112/105/112105206/
- https://archive.nptel.ac.in/courses/112/104/112104118/
- https://www.edx.org/learn/fluid-mechanics
- https://onlinecourses.nptel.ac.in/noc20_ce30/previewnptel.ac.in
- www.coursera.org/learn/fluid-powerera

B.Tech. (IV Sem.) **23ME08 - THEORY OF MACHINES**

L	T	P	C
3	0	0	3

Pre-requisites: Mechanics of Solids

Course Objectives: The objectives of the course are to make the students learn about

- Identify the basic components, layout and kinematics of mechanisms
- Familiarize velocity and acceleration in mechanisms.
- Explain the importance of gyroscopic couples and turning moment diagrams.
- Familiarize balancing principles for rotating masses
- Introduce the equation of motion for single degree of freedom vibrating system.

Course Outcomes: At the end of the course students will be able to

CO	Statements
CO1	Understand different mechanisms and their inversions. **(Understanding- L2)**
CO2	Analyze velocity and acceleration of different links in a mechanism. **(Analyzing-L4)**
CO3	Apply the gear kinematics in various machines and Gyroscopic principles in various vehicles. **(Applying-L3)**
CO4	Evaluate unbalance mass in rotating machines and draw various cam profiles. **(Analyzing-L4)**
CO5	Analyze vibrations of single degree freedom systems and turning moment diagrams of various engines. **(Analyzing-L4)**

UNIT – I: Simple Mechanisms

Simple Mechanisms: Classification of mechanisms – Basic kinematic concepts and definitions – Degree of freedom, mobility – Grashof's law, kinematic inversions of four bar chain and slider crank chains- Limit positions – Mechanical advantage- Transmission angle- Description of some common mechanisms- Quick return mechanism, straight line mechanisms – Universal Joint – Rocker mechanisms.

UNIT – II: Plane and motion analysis

Plane and motion analysis: Displacement, velocity and acceleration analysis of simple mechanisms, graphical velocity analysis using instantaneous centers, velocity and acceleration analysis using relative velocity method– kinematic analysis of simple mechanisms – Coriolis component of acceleration.

UNIT – III: Gyroscope & Gear Profile

Gyroscope: Principle of gyroscope, gyroscopic effect in an aeroplane, ship, car and two wheeler, simple problems

Gear Profile: Involute and cycloidal gear profiles, gear parameters, fundamental law of gearing and conjugate action, spur gear contact ratio and interference/undercutting – Introduction to helical, bevel, worm, rack & pinion gears, epicyclic and regular gear train kinematics.

UNIT – IV: Balancing of Rotating masses & Cams

Balancing of Rotating masses: Need for balancing, balancing of single mass and several masses in

different planes, using analytical and graphical methods.

Cams: Classification of cams and followers- Terminology and definitions – Displacement diagrams –Uniform velocity, parabolic, simple harmonic and cycloidal motions – derivatives of follower motions- specified contour cams- circular and tangent cams.

UNIT – V: Vibrations & Turning Moment Diagrams and Flywheels

Vibrations: Introduction, degree of freedom, types of vibrations, free natural vibrations, Newton method and energy method for single degree of freedom. Damped vibrations- under damped, critically damped; and over damped systems, basics of forced vibrations in single degree of freedom; Vibration isolation and transmissibility.

Turning Moment Diagrams and Flywheels: Turning moment diagrams for steam engine, I.C engine and Multi Cylinder Engine. Crank effort – coefficient of fluctuation of energy, coefficient of fluctuation of speed – Fly Wheel and their design.

Text Books:

1. S.S.Rattan, Theory of Machines, 4/e, Tata Mc-Graw Hill, 2014.
2. P.L.Ballaney, Theory of Machines & Mechanisms, 25/e, Khanna Publishers, Delhi, 2003.

Reference Books:

1. F. Haidery, Dynamics of Machines, 5/e, NiraliPrakashan, Pune, 2003.
2. J.E.Shigley, Theory of Machines and Mechanisms, 4/e, Oxford, 2014.
3. G.K.Groover, Mechanical Vibrations, 8/e, Nemchand Bros, 2009.
4. Norton, R.L., Design of Machinery – An Introduction to Synthesis and Analysis of Mechanisms and Machines, 2/e, McGraw Hill, New York, 2000.
5. William T. Thomson, Theory of vibration with applications, 4/e, Englewood Cliffs, N.J.: Prentice Hall, 1993.

B.Tech. (IV Sem.) **23HS03 - INDUSTRIAL MANAGEMENT**

L	T	P	C
2	0	0	2

Pre-requisites: Nil

Course Objectives: T e objectives of the course are to

- Introduce the scope and role of industrial engineering and the technique for optimal design of layouts
- Illustrate how work study is used to improve productivity
- Explain TQM and quality control techniques
- Introduce financial management aspects and
- Discuss human resource management and value analysis.

Course Outcomes: At the end of the course students will be able to

COs	Statements
CO1	Design the key factors and techniques for optimizing and maintaining plant layouts. **(Applying-L3)**
CO2	Demonstrate various work study techniques and evaluate the principles of ergonomics and tools. **(Applying-L3)**
CO3	Investigate statistical quality control methods and value the concepts of total quality management. **(Applying-L3)**
CO4	Investigate the scope and nature of financial management techniques. **(Applying-L3)**
CO5	Integrate human resource management, personnel management, and industrial relations concepts and functions. **(Applying-L3)**

UNIT– I

INTRODUCTION: Definition of Industrial Engineering (I.E), development, applications, role of an Industrial Engineer, differences between Production Management and Industrial Engineering, quantitative tools of IE and productivity measurement. concepts of management, importance, functions of management, scientific management, Taylor's Principles, theory X and theory Y, Fayol's principles of management.

PLANT LAYOUT: Factors governing plant location, types of plant layouts, advantages and disadvantages of process layout and product layout, applications, quantitative techniques for optimal design of layouts, plant maintenance, preventive and break down maintenance.

UNIT–II

WORK STUDY: Importance, types of production, applications, work study, method study and time study, work sampling, PMTS, micro-motion study, rating techniques, MTM, work factor system, principles of Ergonomics, flow process charts, string diagrams and Therbligs.

UNIT–III

STATISTICAL QUALITY CONTROL: Quality control, Queuing assurance and its importance, SQC, attribute sampling inspection with single and double sampling, Control charts - $\bar{X}$ and R -

charts *X* and *S* charts and their applications, numerical examples.

TOTAL QUALITY MANAGEMENT: zero defect concept, quality circles, implementation, applications, ISO quality systems. Six Sigma–definition, basic concepts

UNIT– IV

FINANCIAL MANAGEMENT: Scope and nature of financial management, Sources of finance, Ratio analysis, Management of working capital, estimation of working capital requirements, stock management, Cost accounting and control, budget and budgetary control, Capital budgeting – Nature of Investment Decisions – Investment Evaluation criteria- NPV, IRR, PI, Payback Period, and ARR, numerical problems.

UNIT–V

HUMAN RESOURCE MANAGEMENT: Concept of human resource management, personnel management and industrial relations, functions of personnel management, Job- evaluation, its importance and types, merit rating, quantitative methods, wage incentive plans, and types.

VALUE ANALYSIS: Value engineering, implementation procedure, enterprise resource planning and supply chain management.

Text Books:

1. O.P Khanna, Industrial Engineering and Management, Dhanpat Rai Publications (P) Ltd, 2018.
2. Mart and Telsang, Industrial Engineering and Production Management, S.Chand &Company Ltd. New Delhi, 2006.

Reference Books:

1. Bhattacharya DK, Industrial Management,S.Chand, publishers, 2010.
2. J.G Monks, Operations Management,3/e, McGraw Hill Publishers1987.
3. T.R. Banga, S.C.Sharma, N. K. Agarwal, Industrial Engineering and Management Science, Khanna Publishers, 2008.
4. KoontzO' Donnell, Principles of Management, 4/e, McGraw Hill Publishers, 1968.
5. R.C. Gupta, Statistical Quality Control, Khanna Publishers, 1998.
6. NVS Raju, Industrial Engineering and Management,1/e, Cengage India Private Limited, 2013.

Online Learning Sources:

- https://onlinecourses.nptel.ac.in/noc21_me15/preview
- https://onlinecourses.nptel.ac.in/noc20_mg43/preview
- https://www.edx.org/learn/industrial-engineering
- https://youtube.com/playlist?list=PL299B5CC87110A6E7&si=TghLCbEobuxjEaXi
- https://youtube.com/playlist?list=PLbjTnjt5Gkl0z3OHOGK5RB9mvNYvnImW&si=oaX_5RG69hS3v2ll

B.Tech. (IV Sem.)

23ME55 - FLUID MECHANICS & HYDRAULIC MACHINES LAB

L	T	P	C
0	0	3	1.5

Pre-requisites: Engineering Mechanics

Course Objective: To impart practical exposure on the performance evaluation methods of various flow measuring equipment and hydraulic turbines and pumps.

Course Outcomes: At the end of the course students will be able to

COs	Statements
CO1	Demonstrate the devices used for measuring flow. **(Applying-L3)**
CO2	Compute major losses in pipes. **(Evaluating-L5)**
CO3	Illustrate the operating parameters of turbines. **(Understanding-L2)**
CO4	Explain the working of different types of pumps. **(Understanding-L2)**
CO5	Explain the devices used for measuring flow. **(Understanding-L2)**

List of Experiments:

1. Impact of jets on Vanes.
2. Performance Test on Pelton Wheel.
3. Performance Test on Francis Turbine.
4. Performance Test on Kaplan Turbine.
5. Performance Test on Single Stage Centrifugal Pump.
6. Performance Test on Multi Stage Centrifugal Pump.
7. Performance Test on Reciprocating Pump.
8. Calibration of Venturimeter.
9. Calibration of Orificemeter.
10. Determination of friction factor for a given pipeline.
11. Determination of loss of head due to sudden contraction in a pipeline.
12. Turbine flow meter.

Virtual Lab:

1. To study different patterns of a flow through a pipe and correlate them with the Reynolds number of the flow. (https://me.iitp.ac.in/Virtual-Fluid-Laboratory/reynolds/introduction.html)
2. To calculate Total Energy at different points of venture meter. (https://me.iitp.ac.in/Virtual-Fluid-Laboratory/bernoulli/introduction.html).
3. To calculate the flow (or point) velocity at center of the given tube using different flow rates. (https://me.iitp.ac.in/Virtual-Fluid-Laboratory/pitot/introduction.html)
4. To determine the hydrostatic force on a plane surface under partial submerge and full submerge condition. (https://me.iitp.ac.in/Virtual-Fluid-Laboratory/cop/introduction.html).
5. To determine the discharge coefficient of a triangular notch. (https://me.iitp.ac.in/Virtual-Fluid-Laboratory/notch/introduction.html)
6. To determine the coefficient of impact of jet on vanes. (https://fm-nitk.vlabs.ac.in/exp/impact-of-jet).
7. To determine friction in pipes. (https://fm-nitk.vlabs.ac.in/exp/friction-in-pipes/index.html).

B.Tech. (IV Sem.)

23ME56- MANUFACTURING PROCESSES LAB

L	T	P	C
0	0	3	1.5

Pre-requisites: Engineering Workshop, Engineering Graphics

Course Objective: Acquire practical knowledge on Metal Casting, Welding, Press Working and Processing of Plastics.

Course Outcomes: At the end of the course students will be able to

COs	Statements
CO1	Make moulds for sand casting. **(Understanding-L2)**
CO2	Fabricate different types of components using various manufacturing techniques. **(Applying-L3)**
CO3	Adapt conventional manufacturing methods. **(Applying-L3)**
CO4	Develop Different Weld joints. **(Applying-L3)**

List of Experiments

1. Design and making of pattern
    I. Single piece pattern
    II. Split pattern
2. Sand properties testing
    I. Sieve analysis (dry sand)
    II. Clay content test
    III. Moisture content test
    IV. Strength test (Compression test & Shear test)
    V. Permeability test
3. Mould preparation
    I. Straight pipe
    II. Bent pipe
    III. Dumble
    IV. Gear blank
4. Gas cutting and welding
5. Manual metal arc welding
    I. Lap joint
    II. Butt joint
6. Injection Molding
7. Blow Molding
8. Simple models using sheet metal operations
9. Study of deep drawing and extrusion operations
10. To make weldments using TIG/MIG welding
11. To weld using Spot welding machine
12. To join using Brazing and Soldering
13. To make simple parts on a 3D printing machine
14. Demonstration of metal casting.

Virtual Lab:

1. To study and observe various stages of casting through demonstration of casting process. (https://virtual-labs.github.io/exp-sand-casting-process- dei/theory.html)
2. To weld and cut metals using an oxyacetylene welding setup. (https://virtual-labs.github.io/exp-gas-cutting-processes-iitkgp/index.html).
3. To simulate Fused deposition modelling process (FDM) (https://3dpdei.vlabs.ac.in/exp/simulation-modelling-process)

B.Tech. (IV Sem.)

23ME57- DESIGN THINKING & INNOVATION

L	T	P	C
1	**0**	2	**2**

Pre-requisites: None

Course Objective: The objectives of the course are to

- Bring awareness on innovative design and new product development.
- Explain the basics of design thinking.
- Familiarize the role of reverse engineering in product development.
- Train how to identify the needs of society and convert into demand.
- Introduce product planning and product development process.

Course Outcomes: At the end of the course students will be able to

COs	Statements
CO1	Apply fundamental design components, principles, and new materials to create and improve design projects. **(Applying-L3)**
CO2	Apply the design thinking process to develop and present innovative product solutions. **(Applying-L3)**
CO3	Analyze the relationship between creativity and innovation, evaluate their roles in organizations, and develop strategic plans for transforming creative ideas into innovative solutions. **(Analyzing-L4)**
CO4	Analyze to work in a multidisciplinary environment. **(Analyzing-L4)**
CO5	Apply design thinking principles to address business challenges, develop and test business models and prototypes, and evaluate the value of creativity. **(Evaluating-L5)**

UNIT – I Introduction to Design Thinking

Introduction to elements and principles of Design, basics of design-dot, line, shape, form as fundamental design components. Principles of design. Introduction to design thinking, history of Design Thinking, New materials in Industry.

UNIT – II Design Thinking Process

Design thinking process (empathize, analyze, idea & prototype), implementing the process in driving inventions, design thinking in social innovations. Tools of design thinking - person, costumer, journey map, brainstorming, product development

Activity: Every student presents their idea in three minutes, Every student can present design process in the form of flow diagram or flow chart etc. Every student should explain about product development.

UNIT – III Innovation

Art of innovation, Difference between innovation and creativity, role of creativity and innovation in organizations. Creativity to Innovation. Teams for innovation, Measuring the impact and value of creativity.

Activity: Debate on innovation and creativity, Flow and planning from idea to innovation, Debate on value-based innovation.

UNIT – IV Product Design

Problem formation, introduction to product design, Product strategies, Product value, Product planning, product specifications. Innovation towards product design Case studies.

Activity: Importance of modeling, how to set specifications, Explaining their own product design.

UNIT – V Design Thinking in Business Processes

Design Thinking applied in Business & Strategic Innovation, Design Thinking principles that redefine business – Business challenges: Growth, Predictability, Change, Maintaining Relevance, Extreme competition, Standardization. Design thinking to meet corporate needs. Design thinking for Startups. Defining and testing Business Models and Business Cases. Developing & testing prototypes.

Activity: How to market our own product, about maintenance, Reliability and plan for startup.

Textbooks:

1. Tim Brown, Change by design, 1/e, Harper Bollins, 2009.
2. Idris Mootee, Design Thinking for Strategic Innovation, 1/e, Adams Media, 2014.

Reference Books:

1. David Lee, Design Thinking in the Classroom, Ulysses press, 2018.
2. Shrrutin N Shetty, Design the Future, 1/e, Norton Press, 2018.
3. William lidwell, Kritinaholden, &Jill butter, Universal principles of design, 2/e, Rockport Publishers, 2010.
4. Chesbrough.H, The era of open innovation, 2003.

Online Learning Resources:

- https://nptel.ac.in/courses/110/106/110106124/
- https://nptel.ac.in/courses/109/104/109104109/
- https://swayam.gov.in/nd1_noc19_mg60/preview
- https://onlinecourses.nptel.ac.in/noc22_de16/preview

B.Tech. (IV Sem.)

23MES1- STRUCTURAL AND MODAL ANALYSIS USING ANSYS

L	T	P	C
0	1	2	2

Pre-requisites: Mechanics of Solids

Course Objective: The main objective of this course is to improve the modelling and analysis skills of students inANSYS workbench and enable them to solve problems related to structures and machine members.

Course Outcomes: At the end of the course students will be able to

COs	Statements
CO1	Understand the basics and fundamentals related to Finite Element Method. **(Understanding-L2)**
CO2	Comprehend the ANSYS utilities to solve the engineering problems. **(Understanding-L2)**
CO3	Perform the static structural analysis in 1D, 2D and 3D using ANSYS work bench. **(Applying-L3)**
CO4	Analyze the mode shapes of structures and machine elements. **(Analyzing-L4)**

Exercises are to be conducted using ANSYS Workbench software:

1. Introduction to Finite Element Method
2. Basics of ANSYS interface and its utilities
3. Structural Analysis of Stepped Bar and Tapered Bar.
4. Static Analysis of a Planar Truss.
5. Static Analysis of a Cantilever Beam.
6. Static Analysis of a Simply Supported Beam.
7. Static Analysis of a Fixed Beam.
8. Stress Analysis of Flat Plates and Simple Shells.
9. Stress Analysis of Axi-symmetric Components.
10. Vibration Analysis of Spring-Mass Systems.
11. Modal Analysis of a Cantilever Beam.
12. Modal Analysis of a Simply Supported Beam.
13. Modal Analysis of a Fixed Beam.
14. Modal Analysis of Flat Plates and Simple Shells.

WEB REFERENCES:

1. https://www.slideshare.net/nageshsurner/introduction-to-ansys-workbench-80635115
2. https://www.youtube.com/watch?v=C8WvCQpzT2A
3. https://www.youtube.com/watch?v=FwKkjAr9Kbk
4. https://www.youtube.com/watch?v=6QaFX1CG-ZE

B.Tech. (V Sem.)

23ME10- MACHINE TOOLS AND METROLOGY

L	T	P	C
3	0	0	3

PRE-REQUISITES: Production Technology

COURSE EDUCATIONAL OBJECTIVES:

This course aims to impart fundamental knowledge and principles of material removal processes, along with a comprehensive understanding of the basic working principles of lathe, shaping, slotting, and planning machines. It also focuses on demonstrating the fundamentals of drilling, milling, and boring operations. Additionally, the course discusses advanced finishing processes, limits, and fits, while providing insight into the concepts of surface roughness and the application of optical measuring instruments.

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

- **CO1** Describe the principles of metal cutting, chip formation, tool nomenclature, and tool life, and demonstrate basic lathe operations. (**Understanding – L2**)
- **CO2** Identify the construction, working principles, specifications, and operations of shaping, slotting, planning, drilling, and boring machines, including their key components and mechanisms. (**Understanding – L2**)
- **CO3** Operate drilling, boring, and milling machines to perform machining processes, and demonstrate the ability to produce keyways and gears using milling machines by applying indexing mechanisms. (**Applying – L3**)
- **CO4** Select suitable finishing processes, grinding wheels, and apply concepts of limits, fits, and gauge design for quality control and dimensional accuracy. **(Applying – L3)**
- **CO5** Apply suitable instruments for angular, surface roughness, and optical measurements, and interpret the measurement data for quality inspection of components. **(Applying – L3)**

UNIT – I: INTRODUCTION, FUNDAMENTALS OF MACHINING AND LATHE MACHINES:

Elementary treatment of metal cutting theory – element of cutting process – Single point cutting tools, nomenclature, tool signature, mechanism of metal cutting, types of chips, Taylor's tool life equation, simple problems.

LATHE MACHINES:

Introduction- types of lathes - Engine lathe – principle of working - construction - specification of lathe - accessories and attachments – lathe operations – taper turning methods and thread cutting – drilling on lathes.

UNIT – II: SHAPER, SLOTTER, PLANAR, DRILLING AND BORING MACHINES

SHAPING, SLOTTING AND PLANNING MACHINES: Introduction - principle of working – principle parts – specifications - operations performed - slider crank mechanism.

DRILLING & BORING MACHINES: Introduction – construction of drilling machines – types of drilling machines - principles of working – specifications- types of drills - operations performed - Boring Machines – types.

UNIT – III: MILLING MACHINES, FINISHING PROCESSES

MILLING MACHINES: Introduction - principle of working – specifications – milling methods - classification of Milling Machines –types of cutters - methods of indexing-

FINISHING PROCESSES: Classification of grinding machines- types of abrasives- bonds, specification and selection of a grinding wheel- Lapping, Honing & Broaching operations- comparison to grinding.

UNIT – IV: LIMITS, FITS AND LINEAR MEASUREMENT

SYSTEMS OF LIMITS AND FITS: Types of fits -Unilateral and bilateral tolerance system, hole and shaft basis systems- interchangeability & selective assembly- International standard system of tolerances, simple problems related to limits and fits, Taylor's principle – design of go and no go gauges; plug, ring, snap, gap, taper, profile and position gauges.

LINEAR MEASUREMENT: Length standards, end standards, slip gauges- calibration of the slip Gauges, dial indicators, micrometres.

UNIT – V: ANGULAR MEASUREMENT, SURFACE ROUGHNESS MEASUREMENT, OPTICAL MEASURING INSTRUMENTS

ANGULAR MEASUREMENT: Bevel protractor, angle slip gauges- angle dekkor- spirit levels- sine bar- sine table.

SURFACE ROUGHNESS MEASUREMENT: Differences between surface roughness and surface waviness –Numerical assessment of surface finish, Profilograph, Talysurf, ISI symbols.

OPTICAL MEASURING INSTRUMENTS: Tools maker's microscope, Autocollimators, Optical projector, Optical flats-working principle, construction, merits, demerits and their uses. optical comparators.

TEXT-BOOKS:

1. Manufacturing Processes / JP Kaushish/ PHI Publishers-2nd Edition
2. Manufacturing Technology–Metal Cutting and Machine Tools, P.N. Rao, Tata McGraw Hill, New Delhi, 2000.
3. Manufacturing, Engineering & Technology. Kalpakjian, S. and Steven R. Schmid, Pearson Education, 2013
4. Machine Tool Design, N.K. Mehta, Tata McGraw Hill, 2012
5. Engineering Metrology, I.C. Gupta, Dhanpat Rai & Sons,2003
6. Engineering Metrology, R. K. Jain, Khanna Publishers, 19/e, 2005.

REFERENCE BOOKS:

1. Metal cutting and machine tools /Geoffrey Boothroyd, Winston A.Knight/ Taylor & Francis
2. Production Technology / H.M.T. Hand Book (Hindustan Machine Tools).
3. Production Engineering/K.C Jain & A.K Chitaley/PHI Publishers
4. Technology of machine tools/S.F.Krar, A.R. Gill, Peter SMID/ TMH
5. Manufacturing Processes for Engineering Materials-Kalpak Jian S & Steven R Schmid/Pearson Publications 5th Edition
6. Elements of Workshop Technology, Vol. II, S.K. Hajra Chowdary, and A.K. Hajra Chowdary, Asia Publishing House, Bombay, 2003.

ONLINE RESOURCES

1. https://nptel.ac.in/courses/112/105/112105127/
2. https://nptel.ac.in/courses/112/106/112106179

L	T	P	C
3	0	0	3

B.Tech. (V Sem.) **23ME11- THERMAL ENGINEERING**

PRE-REQUISITES: Thermodynamics

COURSE EDUCATIONAL OBJECTIVE:

The objective of this course is to acquire the knowledge on construction, operation, combustion and performance of IC engines. To understand the fundamentals of steam and gas power cycles, components, functions and its power output analysis. Also to gain insights on the compressors and applications.

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

CO1: Discuss the fundamental concepts of IC engines and combustion phenomenon. **(Understanding – L2)**

CO2: Describe the functioning of a vapour power cycle, boilers and draught systems. **(Understanding – L2)**

CO3: Apply thermodynamic principles to find the performance parameters of steam nozzles and steam condensers. **(Applying – L3)**

CO4: Determine the power output from steam and gas turbines. **(Applying – L3)**

CO5: Demonstrate the working of different compressors and their comparisons **(Understanding – L2)**

UNIT – I

I.C ENGINES: I.C. engine components and nomenclature, Classification of I.C. Engines, Ideal and Actual Working Cycles. The working principles of 2-stroke and 4-stroke SI and CI engines, Comparison of 2-Stroke and 4-Stroke Engines; CI and SI Engines, Valve timing and Port timing diagrams, Engine Performance and testing parameters, Heat balance test.

COMBUSTION IN IC ENGINES: Normal and abnormal combustion**,** Stages of combustion in SI engines, Stages of combustion in CI engines, Knocking, Factors affecting the Knocking, Octane Number and Cetane Number, Firing order.

UNIT – II

VAPOUR POWER CYCLES: Introduction, Carnot Vapour Power Cycle, Rankine Cycle, Actual Vapour Power Cycle, Methods to improve efficiency of Rankine cycle – Reheating and Regeneration. Fuels used in steam power plants.

BOILERS AND DRAUGHT SYSTEM: Introduction, Boiler - Function and Classification, Fire Tube boilers–Cochran, Cornish, Lancashire, Water Tube boilers - Babcock and Wilcox, Comparison of fire and water tube boilers, High pressure boilers - Benson boiler, Lamont Boiler, Loeffler boiler. Mountings and Accessories. Draught Systems – Natural and artificial draught

UNIT – III

STEAM NOZZLES: Introduction**,** Types of nozzle, Flow through nozzles- thermodynamic Analysis, velocity of nozzle at exit, condition for maximum discharge, critical pressure ratio, Ideal and actual expansion in nozzle, velocity coefficient.

STEAM CONDENSERS: Introduction, Elements of a condenser plant, Types of Condensers- Jet condensers – working principle, Surface Condensers-working principle, Comparison of jet and surface condensers, Condenser performance parameters.

UNIT – IV

STEAM TURBINES: Introduction, Classification, Impulse turbine - working principle, Velocity diagrams – effect of friction – power developed, axial thrust, blade or diagram efficiency – condition for maximum efficiency. De-Laval Turbine - its features. Methods to reduce rotor speed-velocity compounding (Curtis Turbine), Pressure compounding (Rateau Turbine) and pressure and velocity compounding. Reaction Turbines- Parson's reaction turbine, performance analysis, degree of reaction, condition for maximum efficiency.

GAS TURBINES AND JET PROPULSION SYSTEMS: Introduction, Classification, working and application of Gas Turbines, Ideal and Actual Cycles; Methods to improve the gas turbine performance- Inter cooling, Reheating, Regeneration.

Jet Propulsion: Introduction, Classification, -Turbo jet, Turbo Propeller-Rocket Engines (Theory only).

UNIT – V

COMPRESSORS:

RECIPROCATING COMPRESSORS: Introduction, Classification, Reciprocating compressors – Single, double and multistage compressors working principle, Power requirement of reciprocating compressors, volumetric efficiency, condition for maximum efficiency in multi stage compressor.

ROTARY, AXIAL AND CENTRIFUGAL COMPRESSORS: Introduction, general classification, Rotary compressors **–** Working principle of Root's, Vane's and Lysholm compressor, axial and centrifugal compressors– surging and choking in compressors and their comparisons-applications[theory].

TEXT BOOKS:

T1 V. Ganesan, I.C. Engines, Mc Graw Hill, 4th Edition, 2017
T2 M.L.Mathur & F.S.Mehta, Thermodynamics and Heat Power Engineering
T3 Mahesh. M. Rathore, Thermal Engineering, TMH.

REFERENCE BOOKS:

R1 Er.R.K.Rajput, Thermal Engineering, Laxmi Publications, 11th Edition, 2020.
R2 T.D. Eastop and A. McConkey, Applied Thermodynamics, Pearson, 5th Edition, 2013.
R3 P.K. Nag, Power Plant Engineering, McGraw Hill Education,4th Edition, 2017
R4 H.N Gupta, Fundamentals of Internal Combustion Engines, PHI, 2nd Edition, 2013.

B.Tech. (V Sem.) **23ME12-DESIGN OF MACHINE ELEMENTS**

L	T	P	C
3	0	0	3

PRE-REQUISITES: Engineering Mechanics, Mechanics of Solids

COURSE EDUCATIONAL OBJECTIVE:

The main objective of this course is to familiarize the steps involved in the design process of various machine elements and apply the standard procedure available for the design of mechanical components.

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

- **CO1:** Apply various theories of failure to the mechanical systems under static and dynamic loading. **(Applying – L3)**
- **CO2:** Estimate the strength of joints subjected to various types of loads. **(Applying – L3**)
- **CO3:** Design the shafts and couplings for transmitting the power**. (Applying – L3)**
- **CO4:** Design the gears and springs for various applications of engineering. **(Analyzing – L4)**
- **CO5:** Select suitable bearings under various loading conditions**. (Analyzing – L4)**

UNIT – I: **INTRODUCTION TO DESIGN, DESIGN FOR STATIC AND DYNAMIC LOADS**

MECHANICAL ENGINEERING DESIGN: Classification of machine design, Basic procedure of machine design, Basic considerations of machine elements, Codes and standards of designation of materials, Selection of materials.

DESIGN FOR STATIC LOADS: Modes of failure, Factor of safety, Theories of failure - Maximum principal stress theory, Maximum shear stress theory and Distortion energy theory, Design of components subjected to axial, bending and torsional loads.

DESIGN FOR DYNAMIC LOADS: Stress concentration, Stress concentration factors, Methods of reducing stress concentration, Notch sensitivity, Fluctuating stresses, Fatigue failure, Endurance limit, S-N diagram, Soderberg and Goodman theories, Fatigue design under single load only, Design for infinite life.

UNIT – II: DESIGN OF BOLTED AND WELDED JOINTS

DESIGN OF BOLTED JOINTS: Threaded fasteners, preload of bolts, various stresses induced in the bolts, Torque requirement for bolt tightening, gasketed joints.

DESIGN OF WELDED JOINTS: Strength of lap and butt welds, Joints subjected to bending and torsion.

UNIT – III: POWER TRANSMISSION SHAFTS, KEYS AND COUPLINGS

POWER TRANSMISSION SHAFTS: Shaft design on strength basis, Shafts subjected to combined twisting moment and bending moment, Design of shafts carrying gears & pulleys with flat belts, Design of shafts based on rigidity.

KEYS: Types of keys, Key failures by shear and compression, Design of saddle and sunk keys.

COUPLINGS: Types of couplings, Design of flange and bushed pin couplings.

UNIT – IV: DESIGN OF GEARS AND SPRINGS

DESIGN OF GEARS: Introduction-Spur gears–Lewis equation-Beam strength of gear tooth–Design of spur gears - Design for dynamic and wear loads.

DESIGN OF SPRINGS: Types of springs, Design of helical compression, tension and leaf springs.

UNIT – V: DESIGN OF BEARINGS

DESIGN OF JOURNAL BEARINGS: Types of Journal bearings, Theory of lubrication, Selection of bearing modulus from design tables, Mc Kee's equation, Heat generation and heat dissipation of bearings, Bearing materials, Journal bearing design, Bearing failures.

DESIGN OF BALL BEARINGS: Static load carrying capacity, Dynamic load carrying capacity, Load factors, Equivalent bearing load, Selection of bearing life, Design for cyclic loads and speeds, Selection of bearings from manufacturer's catalogue.

TEXT BOOKS:

T1 R.L. Norton, Machine Design an Integrated approach, 2nd Edition, Pearson Education, 2004.

T2 Bhandari V.B, Design of Machine Elements, 3rd Edition, TataMcGraw-Hill2010

T3 Dr. N. C. Pandya & Dr. C. S. Shah, Machine design, 17th Edition, Charotar Publishing House Pvt. Ltd, 2009.

REFERENCE BOOKS:

R1 R.K. Jain, Machine Design, Khanna Publications, 1978.

R2 J.E. Shigley, Mechanical Engineering Design, 2nd Edition, Tata McGraw Hill, 1986

R3 M.F.Spotts and T.E.Shoup, Design of Machine Elements, 3rd Edition, Prentice Hall (Pearson Education), 2013.

B.Tech. (V Sem.) **23ME13- DESIGN FOR MANUFACTURING**

L	T	P	C
3	0	0	3

PRE-REQUISITES: Manufacturing Processes, Design of Machine Elements

COURSE EDUCATIONAL OBJECTIVES:

This course aims to provide students with fundamental knowledge of product and process design for manufacturing and assembly. It covers design principles for manual assembly, machining, casting, extrusion, sheet metal work, and metal joining processes. The course also introduces basic concepts of assembly automation to enhance manufacturability and efficiency.

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

- **CO1** Understand the fundamental concepts and principles of design for manual assembly. **(Understanding – L2)**
- **CO2** Identify and explain the basic design procedures involved in various machining processes. **(Understanding – L2)**
- **CO3** Illustrate the design considerations in metal casting, extrusion, and sheet metal forming processes. **(Understanding – L2)**
- **CO4** Interpret the key design aspects of various metal joining processes, including welding and mechanical fastening. **(Applying – L3)**
- **CO5** Understand the core design concepts related to assembly automation systems. **(Understanding – L2)**

UNIT-I: INTRODUCTION TO DESIGN FOR MANUFACTURING

INTRODUCTION TO DFM, DFMA: How Does DFMA Work? Reasons for Not Implementing DFMA, What Are the Advantages of Applying DFMA During Product Design? Typical DFMA Case Studies, Overall Impact of DFMA on Industry.

DESIGN FOR MANUAL ASSEMBLY: General Design Guidelines for Manual Assembly, Development of the Systematic DFA Methodology, Assembly Efficiency, Effect of Part Symmetry, Thickness, weight on Handling Time, Effects of Combinations of Factors and application of the DFA Methodology.

UNIT– II: DESIGN CONSIDERATIONS OF MACHINE PARTS

MACHINING PROCESSES: Overview of various machining processes-general design rules for machining dimensional tolerance and surface roughness-Design for machining – ease –redesigning of components for machining ease with suitable examples. General design recommendations for machined parts.

UNIT – III: DESIGN ASPECTS OF CASTING AND EXTRUSION PROCESSES

METAL CASTING: Appraisal of various casting processes, selection of casting process, general design considerations for casting, casting tolerance, use of solidification, simulation in casting design, product design rules for sand casting.

EXTRUSION & SHEET METAL WORK: Design guidelines, extruded sections, design principles for punching, blanking, bending, and deep drawing, Keeler Goodman forging line diagram, component design for blanking.

UNIT– IV: DESIGN CONSIDERATIONS OF METAL JOINING PROCESSES

Metal joining: Appraisal of various welding processes, factors in design of weldments – general design guidelines, pre- and post-treatment of welds, effects of thermal stresses in weld joints, design of brazed joints. Forging: Design factors for forging – closed die forging design – parting lines of dies –drop forging die design – general design recommendations.

UNIT– V: **DESIGNING FOR ASSEMBLY AUTOMATION AND DESIGN FOR MANUFACTURING**

DESIGN FOR ASSEMBLY AUTOMATION: Fundamentals of automated assembly systems, System configurations, parts delivery system at workstations, various escapement and placement devices used in automated assembly systems, Quantitative analysis of Assembly systems, multi-station assembly systems, and single-station assembly lines.

DESIGN FOR ADDITIVE MANUFACTURING:

Introduction to AM, DFMA concepts and objectives, AM unique capabilities, exploring design freedoms, Design tools for AM, Part Orientation, Removal of Supports, Hollowing out parts, Inclusion of Undercuts and Other Manufacturing Constraining Features, Interlocking Features, Reduction of Part Count in an Assembly, Identification of markings/ numbers.

TEXT BOOKS:

1. Design for manufacture, John Cobert, Adisson Wesley. 1995
2. Design for Manufacture by Boothroyd,
3. Design for manufacture, James Bralla,

REFERENCE:

1. Molloy, E.A. Warman, S. Tilley, Design for Manufacturing and Assembly: Concepts, Architectures and Implementation, Springer, 1998.
2. ASM International, *ASM Handbook, Volume 20: Materials Selection and Design*, ASM International, Materials Park, Ohio, USA, 1997.

B.Tech. (V Sem.)	23ME14- CONVENTIONAL AND FUTURISTIC VEHICLE TECHNOLOGY	L	T	P	C
		3	0	0	3

PRE-REQUISITES:

COURSE OBJECTIVES

This course is designed to provide an in-depth understanding of advanced engine technologies, with a focus on various advanced combustion methods and their advantages. It also covers the use of low carbon fuels, highlighting their significance in reducing emissions. Additionally, the course explores the configurations and working principles of hybrid and electric vehicles, and examines the application of fuel cell technology in the automotive sector, promoting sustainable and energy-efficient transportation solutions.

Course Outcomes*:* At the end of the course the students would be able to

- **CO1:** Demonstrate the latest trends in engine technology. **(Understanding-L2)**
- **CO2:** Describe the need of advanced combustion technologies and its impact on reducing carbon foot-print on the environment. **(Understanding-L2)**
- **CO3:** Compare the basic characteristics of low carbon fuels, its impact over conventional fuels and in achieving sustainable development goals. **(Understanding-L2)**
- **CO4:** Illustrate the working and energy flow in various hybrid and electric configurations. **(Understanding-L2)**
- **CO5:** Interpret the need for fuel cell technology in automotive applications. **(Applying-L3)**

UNIT – I: ADVANCED ENGINE TECHNOLOGY

Gasoline Direct Injection, Common Rail Direct Injection, Variable Compression Ratio Turbocharged Engines, Electric Turbochargers, VVT, Intelligent Cylinder De-activation, After Treatment Technologies, Electric EGR, Current EMS architecture.

UNIT – II: COMBUSTION TECHNOLOGY

Spark Ignition combustion, Compression Ignition Combustion, Conventional Dual Fuel Combustion, Low Temperature Combustion Concepts– Controlled Auto Ignition, Homogeneous Charge Compression Ignition, Premixed Charge Compression Ignition, Partially Premixed Compression Ignition, Reactivity Controlled Compression Ignition, Gasoline Direct Injection Compression Ignition.

UNIT – III: LOW CARBON FUEL TECHNOLOGY

Alcohol Fuels, Ammonia Fuel and Combustion, Methane Technology, Dimethyl Ether, Hydrogen Fuel Technology, Challenges, and way forward

UNIT – IV: HYBRID AND ELECTRIC VEHICLE (BATTERY POWERED)

Conventional Hybrids (Conventional ICE + Battery), Modern Hybrids (RCCI/GDCI Engine + Battery), Pure Electric Vehicle Technology – Challenges and Way forward

UNIT – V: FUEL CELL TECHNOLOGY

Fuel cells for automotive applications - Technology advances in fuel cell vehicle systems - Onboard hydrogen storage - Liquid hydrogen and compressed hydrogen - Metal hydrides, Fuel cell control system - Alkaline fuel cell - Road map to market.

TEXT BOOKS:

1. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.
2. Rakesh Kumar Maurya, Characteristics and Control of Low Temperature Combustion Engines. ISBN 978-3-319-68507-6 , SPRINGER

REFERENCES:

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.
2. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003
3. Rand D.A.J, Woods, R & Dell RM Batteries for Electric vehicles, John Wiley & Sons, 1998
4. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.
5. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003

B.Tech. (V Sem.)	23ME15-MICRO ELECTRO MECHANICAL SYSTEMS	L	T	P	C
		3	0	0	3

PRE-REQUISITES:

COURSE OBJECTIVES:

This course aims to provide a comprehensive understanding of Micro Electro Mechanical Systems (MEMS), focusing on the fundamentals of mechanical sensors and actuators. It explores the design and function of thermal sensors and actuators, and extends to the principles and applications of Micro-Opto-Electro-Mechanical Systems (MOEMS) as well as magnetic sensors and actuators. The course also delves into the design considerations and applications of microfluidic systems, and illustrates the working principles of chemical and biomedical microsystems, offering a multidisciplinary perspective on micro-scale technologies.

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

- **CO1:** Understand basics of Micro Electro Mechanical Systems (MEMS), mechanical sensors and actuators. **(Understanding-L2)**
- **CO2:** Illustrate thermal sensors and actuators used in MEMS. **(Understanding-L2)**
- **CO3:** Apply the principle and various devices of Micro-Opto-Electro Mechanical Systems (MOEMS), magnetic sensors and actuators. **(Applying-L3)**
- **CO4:** Analyze applications and considerations on micro fluidic systems. **(Analyzing-L4)**
- **CO5:** Illustrate the principles of chemical and bio medical micro systems. **(Understanding-L2)**

UNIT – I

INTRODUCTION: Definition of MEMS, MEMS history and development, micro machining, lithography principles & methods, structural and sacrificial materials, thin film deposition, impurity doping, etching, surface micro machining, wafer bonding, LIGA. MECHANICAL SENSORS AND ACTUATORS: Principles of sensing and actuation: beam and cantilever, capacitive, piezo-electric, strain, pressure, flow, pressure measurement by micro phone, MEMS gyroscopes, shear mode piezo actuator, gripping piezo actuator, Inchworm technology.

UNIT – II

THERMAL SENSORS AND ACTUATORS: Thermal energy basics and heat transfer processes, thermistors, thermo devices, thermo couple, micro machined thermo couple probe, Peltier effect heat pumps, thermal flow sensors, micro hot plate gas sensors, MEMS thermo vessels, pyro electricity, shape memory alloys (SMA), U-shaped horizontal and vertical electro thermal actuator, thermally activated MEMS relay, micro spring thermal actuator, data storage cantilever.

UNIT – III

MICRO-OPTO-ELECTRO MECHANICAL SYSTEMS: Principle of MOEMS technology, properties of light, light modulators, beam splitter, micro lens, micro mirrors, digital micro mirror device (DMD), light detectors, grating light valve (GLV), optical switch, wave guide and tuning, shear stress measurement.

MAGNETIC SENSORS AND ACTUATORS: Magnetic materials for MEMS and properties, magnetic sensing and detection, magneto resistive sensor, more on hall effect, magneto diodes, magneto transistor, MEMS magnetic sensor, pressure sensor utilizing MOKE, mag MEMS actuators,

by directional micro actuator, feedback circuit integrated magnetic actuator, large force reluctance actuator, magnetic probe based storage device.

UNIT – IV

MICRO FLUIDIC SYSTEMS: Applications, considerations on micro scale fluid, fluid actuation methods, dielectro-phoresis (DEP), electro wetting, electro thermal flow, thermo capillary effect, electro osmosis flow, opto electro wetting (OEW), tuning using micro fluidics, typical micro fluidic channel, micro fluid dispenser, micro needle, molecular gate, micro pumps. RADIO FREQUENCY (RF) MEMS: RF – based communication systems, RF MEMS, MEMS inductors, tuner/filter, resonator, clarification of tuner, filter, resonator, MEMS switches, phase shifter.

UNIT – V

CHEMICAL AND BIO MEDICAL MICRO SYSTEMS: Sensing mechanism & principle, membrane-transducer materials, chem.-lab-on-a-chip (CLOC) chemo-resistors, chemo-capacitors, chemo-transistors, electronic nose (E-nose), mass sensitive chemo-sensors, fluorescence detection, calorimetric spectroscopy.

TEXT BOOK:

1. MEMS, Nitaigour Premchand Mahalik, TMH

REFERENCE BOOKS:

1. Foundation of MEMS, Chang Liu, Prentice Hall Ltd.
2. MEMS and NEMS, Sergey Edward Lyshevski, CRC Press, Indian Edition.
3. MEMS and Micro Systems: Design and Manufacture, Tai-Ran Hsu, TMH Publishers.
4. Introductory MEMS, Thomas M Adams, Richard A Layton, Springer International Publishers.

L	T	P	C
3	0	0	3

B.Tech. (V Sem.) **23ME16-INDUSTRIAL ROBOTICS**

PRE-REQUISITES: Engineering Mechanics, Kinematics of Machines

COURSE EDUCATIONAL OBJECTIVE: The Students will acquire the knowledge to

This course aims to equip students with foundational knowledge of industrial robotic systems, including their components, applications, and actuation mechanisms. It covers essential topics such as robot kinematics, programming principles, and control systems. Additionally, students will explore the role of image processing and machine vision in robotic applications.

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

- **CO1:** Comprehend the anatomy of a robot and identify the components, configurations, and industrial applications of robotic systems. **(Understanding – L2)**
- **CO2:** Describe the types, characteristics, and selection criteria of actuators and sensors used in robotic systems. **(Understanding – L2)**
- **CO3:** Analyze and solve problems related to forward and inverse kinematics of robotic manipulators. **(Analyzing – L4)**
- **CO4:** Demonstrate the principles of trajectory planning, learn robot programming, and utilize programming languages for robot control. **(Applying – L3)**
- **CO5:** Describe the principles and applications of image processing and machine vision in robotics. **(Understanding – L2)**

UNIT I: INTRODUCTION AND ROBOT ANATOMY

INTRODUCTION: Automation and Robotics, CAD/CAM and Robotics – An overview of Robotics –present and future applications – classification by coordinate system and control system.

COMPONENTS OF THE INDUSTRIAL ROBOTICS: Robot anatomy, work volume, components, number of degrees of freedom - robot drive systems, function line diagram representation of robot arms, common types of arms–requirements and challenges of end effectors, determination of the end effectors.

UNIT – II: ROBOT ACTUATORS AND FEEDBACK COMPONENTS

ACTUATORS: Pneumatic, Hydraulic actuators, electric& stepper motors. Comparison of Electric, Hydraulic and Pneumatic types of actuation devices.

FEEDBACK COMPONENTS: Position sensors–potentiometers, resolvers, encoders–Velocity sensors.

UNIT – III: MANIPULATOR KINEMATICS

MOTION ANALYSIS: Homogeneous transformations as applicable to rotation and translation – problems.

MANIPULATOR KINEMATICS: Specifications of matrices, D-H notation joint coordinates and world coordinates Forward and inverse kinematics–problems.

UNIT – IV: GENERAL CONSIDERATIONS IN PATH DESCRIPTION AND GENERATION

Trajectory planning and avoidance of obstacles, path planning, Skew motion, joint integrated motion –straight line motion–Robot programming, languages and software packages-description of paths with a robot programming language.

UNIT – V: IMAGE PROCESSING AND MACHINE VISION

Introduction to Machine Vision, Sensing and Digitizing function in Machine Vision, Training and Vision System, Robotic Applications.

TEXT BOOKS

1. Saeed B.Niku, Introduction to robotics- analysis, systems &application, Second Edition, Willy India Private Limited, New Delhi,2011.
2. R.K.Mittal and IJ Nagrath, Robotics and Control, Tata McGraw–Hill Publishing company Limited, New Delhi, 2003.

REFERENCES

1. Mikell P.Groover, Mitchell Weiss, Roger N. Nagel and Nicholas G. Odrey,Ashish Dutta, Industrial Robotics, Second Edition McGraw- Hill Education (India) PrivateLimited,2012
2. Robert J.Schilling, Fundamentals of robotics analysis & control, PHI learning private Limited, New Delhi,4th Edition 2002
3. John.JCriag, Introduction to Robotics-Mechanics and Control, Third Edition, Pearson Education,Inc., 2008.

B.Tech. (V Sem.) **23ME58- THERMAL ENGINEERING LAB**

L	T	P	C
0	0	3	1.5

PRE-REQUISITES: Thermodynamics

COURSE EDUCATIONAL OBJECTIVE:

The students to gain practical exposure on working principles of IC engines, carrying out experimental test procedures for finding out the performance characteristics through load test, Morse test and heat balance tests. Also, to gain knowledge on principles of working, operation of Refrigeration test rig, Air Conditioning test rig, Air compressor apparatus and their performance characteristics analysis.

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

CO1: Find the performance characteristics of an internal combustion engines. **(Applying – L3)**

CO2: Estimate the energy distribution and frictional power of diesel engine using heat balance and Morse test. **(Applying - L3)**

CO3: Compute the performance parameters of refrigeration systems. **(Applying – L3)**

CO4: Determine the reciprocating air compressor performance characteristics. **(Analyzing – L4)**

LIST OF EXPERIMENTS (Any 10 experiments):

1. Study of Valve & Port Timing Diagrams of diesel engine and petrol engine.
2. Test on single cylinder 4 -Stroke Diesel Engine by using Mechanical Dynamometer
3. Evaluation of performance parameters of twin cylinder 4-stroke diesel engine.
4. Determination of performance characteristics of 2-Stroke Petrol Engine.
5. Evaluation of engine friction power by conducting Morse test on Multi cylinder diesel engine.
6. Heat Balance of 4 stroke single cylinder diesel engine
7. Performance Test on Reciprocating Air – Compressor.
8. Determination of COP of Vapour Compression Refrigeration Unit.
9. Performance Test on Air Conditioning Unit.
10. Demonstration of automobile working components.
11. Measurement of exhaust emissions and smoke of diesel engine.
12. Analysis of combustion characteristics of the diesel engine.
13. Experimentation on installation of Solar PV Cells.
14. To conduct a performance test on a VCR engine, under different compression ratios.

REFERENCES:

Thermal engineering lab manuals

L	T	P	C
0	0	3	1.5

B.Tech. (V Sem.) **23ME59- THEORY OF MACHINES LAB**

PRE-REQUISITES: Engineering Mechanics, Theory of Machines

COURSE EDUCATIONAL OBJECTIVE:

The main objective of this course is to demonstrate the concepts of theory of machines.

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

CO1: Apply the dynamics of cams, gyroscopes for any practical problems. **(Applying-L3)**

CO2: Evaluate the speed regulations in governors. **(Applying-L3)**

CO3: Verify the balancing for rotating and reciprocating parts of a machine. **(Applying-L3)**

CO4: Determine the vibration parameters of oscillating bodies. **(Applying-L3)**

LIST OF EXPERIMENTS:

At least 10 experiments are to be conducted

1. Determination of gyroscopic couple on Motorized Gyroscope.
2. Determination of centrifugal forces and draw the characteristics curve of Watt and Porter governor.
3. Determination of centrifugal forces and draw the characteristics curve of Proell governor.
4. Determination of centrifugal forces and draw the characteristics curve of Hartnell governor.
5. Study the cam jump phenomenon of various cams and followers.
6. Balance the given rotor system dynamically with the aid of the force polygon and the couple polygon.
7. Balancing of reciprocating masses on slider crank mechanism.
8. Determination of whirling speed of rotating shaft with various boundary conditions.
9. Determination of natural frequency of the spring-mass damped and undamped systems.
10. Determination of natural frequency of torsional vibrations of a single rotor system.
11. Verification of Dunkerley's formula for transverse vibrations of beams with different end conditions.
12. Determination of damped and undamped forced vibrations of beams.
13. To study the various types of gears- spur, helical, worm and bevel gears.
14. To study the various mechanisms and inversions.

REFERENCES: Lab-Manual

B.Tech. (V Sem.)	23MES2-MACHINE TOOLS AND METROLOGY LAB	L	T	P	C
		0	0	4	2

PRE-REQUISITES: Production Technology, Machine Tools and Metrology.

COURSE EDUCATIONAL OBJECTIVE:

The objective of this course is to understand the components of various machine tools and the types of product shapes that can be manufactured using them, as well as to develop the ability to measure bores, angles, and tapers, and to perform alignment tests on different machines.

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

- **CO1:** Identify the components and working principles of general-purpose machine tools, and perform basic operations such as step turning, taper turning, and gear cutting. **(Applying - L3)**
- **CO2:** Perform indexing and keyway cutting operations on milling and slotting machines to manufacture specific shapes and features. **(Applying – L3)**
- **CO3:** Calibrate and use precision instruments such as vernier calipers, micrometers, and height gauges to measure linear and angular dimensions. **(Applying – L3)**
- **CO4:** Conduct machine tool alignment tests and surface roughness measurements using appropriate instruments to assess machine accuracy and component quality. **(Analyzing – L4)**

PART-A: MACHINE TOOLS LAB

At least five experiments may be conducted.

List of Experiments:

1. Introduction of general purpose machines -Lathe, Drilling machine, Milling machine, Shaper, Planing machine, Slotting machine, Cylindrical grinder, Surface grinder and Tool and cutter grinder.
2. Operations on Lathe machines- Step turning, Knurling, Taper turning, Thread cutting and Drilling
3. Operations on Drilling machine - Drilling, reaming, tapping, rectangular drilling, and circumferential drilling
4. Operations on Shaping machine - (i) Round to square (ii) Round to Hexagonal
5. Operations on Slotter - (i) Keyway (T –slot) (ii) Keyway cutting
6. Operations on milling machines - (i) Indexing (ii) Gear manufacturing

PART-B: METROLOGY LAB

At least five experiments may be conducted.

List of Experiments:

1. Calibration of vernier calipers, micrometers, vernier height gauge and dial gauges.
2. Measurement of bores by internal micrometers and dial bore indicators.
3. Use of gear tooth vernier caliper for tooth thickness inspection and flange micrometer for checking the chordal thickness of the spur gear.
4. Machine tool alignment test on the lathe.
5. Machine tool alignment test on the drilling machine.
6. Machine tool alignment test on milling machine.
7. Angle and taper measurements with bevel protractor, Sine bar, rollers and balls.

8. Use of a spirit level in finding the straightness of a bed and the flatness of a surface.
9. Thread inspection with two-wire/three-wire method & tool makers' microscope.
10. Surface roughness measurement with a roughness measuring instrument by Taly Surf.

REFERENCE BOOKS: Lab Manual

B.Tech. (V Sem.) **23EM01-TINKERING LAB**

L	T	P	C
0	0	2	1

PRE-REQUISITES: Design Thinking and Innovation.

COURSE EDUCATIONAL OBJECTIVE:

The main objective of this course is to understand the basics of all the emerging technologies and apply the learnings to solve real-world problems. This is designed to be a hands-on learning program that empowers students to analyze the facts, connect the dots and apply what they learn in school rather than memorizing them which will lead to the creation of the next generation of entrepreneurs, engineers and innovators.

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

CO1: Turn ideas into reality by brainstorming, modelling and prototyping. **(Applying L3)**

CO2: Inculcate innovative and entrepreneurial mind-set through Design thinking and Hands-on Learning. **(Applying-L3)**

CO3: Develop basic knowledge in electrical and mechanical engineering principles. **(Applying-L3)**

CO4: Develop skills of using hand tools to construct a prototype of an engineering design. **(Applying L3)**

List of Experiments:

1) Make your own parallel and series circuits using breadboard for any application of your choice.
2) Demonstrate a traffic light circuit using breadboard.
3) Build and demonstrate automatic Street Light using LDR.
4) Simulate the Arduino LED blinking activity in Tinkercad.
5) Build and demonstrate an Arduino LED blinking activity using Arduino IDE.
6) Interfacing IR Sensor and Servo Motor with Arduino.
7) Blink LED using ESP32.
8) LDR Interfacing with ESP32.
9) Control an LED using Mobile App.
10) Design and 3D print a Walking Robot
11) Design and 3D Print a Rocket.
12) Build a live soil moisture monitoring project, and monitor soil moisture levels of a remote plan in your computer dashboard.
13) Demonstrate all the steps in design thinking to redesign a motor bike.

REFERENCE BOOKS: Lab Manual

WEB REFERENCES: Students need to refer to the following links:

1) https://aim.gov.in/pdf/equipment-manual-pdf.pdf
2) https://atl.aim.gov.in/ATL-Equipment-Manual/
3) https://aim.gov.in/pdf/Level-1.pdf
4) https://aim.gov.in/pdf/Level-2.pdf
5) https://aim.gov.in/pdf/Level-3.pdf

L	T	P	C
3	0	0	3

B.Tech. (VI Sem.) **23ME17- HEAT TRANSFER**

PRE-REQUISITES: Thermodynamics, Thermal Engineering

COURSE EDUCATIONAL OBJECTIVE:

To learn the physical mechanisms on modes of heat transfer, laws of governing equations in heat transfer and applications, steady and unsteady state heat transfer applications and the significance of Non-Dimensional Numbers.

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

- **CO1:** Understand the basic heat transfer principles, mechanisms and its practical relevance in Planes, cylinders and spherical components. **(Understanding-L2)**
- **CO2:** Apply the laws of governing equations to solve the steady and unsteady state one dimensional heat transfer problems. **(Applying-L3)**
- **CO3:** Solve free and forced convection problems related to external and internal flows using empirical correlations. **(Applying-L3)**
- **CO4:** Compute the heat transfer in boiling, condensation and radiation thermal systems. **(Applying-L3)**
- **CO5:** Compare the LMTD, NTU parameters in different heat exchangers for engineering applications using the data handbook. **(Analyzing-L4).**

UNIT – I

INTRODUCTION: Modes of heat transfer - Basic laws of governing equation in heat transfer- Applications of heat transfer - Steady, Unsteady and Periodic Heat Transfer- Heat conduction- Fourier‘s equation- Thermal conductivity-General heat conduction equation in Cartesian, Cylindrical and Spherical Coordinate systems - Initial and boundary conditions.

ONE- DIMENSIONAL STEADY STATE CONDUCTION: One dimensional heat flow through plane walls and cylinder with constant thermal conductivity- Electrical analogy-Thermal resistance-Overall heat transfer coefficient-Applications-Heat flow through Composite wall and cylinder - Critical radius of insulation for Cylinder and Sphere.

UNIT – II

ONE DIMENSIONAL STEADY STATE CONDUCTION: Heat flow through plane wall and cylinder with Variable Thermal conductivity - Uniform internal heat generation in slabs and cylinders-Extended Surfaces- Analysis of Long Fin and Short fin with insulated tip - Fin efficiency and Effectiveness.

ONE DIMENSIONAL TRANSIENT HEAT CONDUCTION: Systems with negligible internal resistance-Lumped Heat analysis for planes, cylinders and sphere –Significance of Biot and Fourier Numbers-systems with finite surface and internal resistance using Heisler Chart for planes.

UNIT – III

FORCED CONVECTION: Introduction, applications – convective heat transfer coefficient-Significance of Non-Dimensional numbers-The boundary layer concept-The velocity and thermal boundary layer, External Flow-laminar and turbulent flow over a flat plate –Internal flow through circular pipe-Laminar and Turbulent Flows - Entry length and fully developed flow - Reynolds Colburn analogy.

NATURAL CONVECTION: Introduction, applications-Development of Hydrodynamic and thermal boundary layer along Vertical plate- Empirical correlations for Vertical plate, Vertical, Cylinder, Horizontal Plate and Horizontal Cylinder.

UNIT – IV

THERMAL RADIATION: Introduction-Applications of Thermal Radiation-Nature of Thermal radiation-Emissive power-Absorption, Reflection and Transmission-Concept of Black body –Laws of Black Body Radiation- Radiation from Nonblack surfaces-Emissivity-Kirchhoff's law - radiation heat exchange between two black isothermal surfaces- shape factor- Heat exchange between nonblack infinite parallel plates.

BOILING AND CONDENSATION: Introduction, Applications of Boiling Heat transfer phenomena- Pool Boiling- Boiling regimes- Critical Heat Flux-Condensation-Film wise and Drop wise condensation-Laminar film wise condensation on Vertical plate.

UNIT – V

HEAT EXCHANGERS: Introduction - Classification of heat exchangers - Flow arrangement, Temperature distribution - Overall heat transfer coefficient - Fouling factor- LMTD method of Heat exchanger analysis for parallel, counter and cross flow heat exchangers, Effectiveness - NTU method of heat exchanger analysis for parallel and counter flow heat exchangers - Applications of Heat Exchangers.

TEXT BOOKS:

T1 R.C.Sachdeva - Fundamentals of Engineering Heat and Mass Transfer -New Age Science Publishers, 3rd Edition, 2009.

T2 Yunus. A. Cengel, Heat & Mass Transfer-A Practical Approach – Tata McGraw Hill, 4thEdition, 2012.

T3 J.P. Holman and S. Bhattacharyya, "Heat Transfer," McGraw Hill, 2017.

REFERENCE BOOKS:

R1 M.Necati Ozisik, Heat Transfer- A basic Approach, 4th Edition, McGraw-Hill book company, 1985.

R2 F.P. Incropera, and D.P. Dewitt, "Fundamentals of Heat and Mass Transfer," John Wiley, 2019.

R3 P.K.Nag, Heat and Mass Transfer- TMH 2nd Edition, 2007.

R4 C.P.Kothandaraman and Subramanian, Heat and Mass Transfer, New Age International Publications 7th Edition 2010.

R5 Dr.D.S.Kumar, " Heat and Mass Transfer", S.K.Kataria and Sons, 9th Edition, 2015, Publisher of Engineering and Computer works

Data Hand Book:

1. C.P. Kothandaraman and Subramanian, Heat and Mass Transfer Data Book, New Age International Publications, 10th Edition, Reprint 2012

NOTE: Heat and Mass Transfer Data Hand Book by C.P. Kothandaraman and Subramanian- New Age Publications is to be allowed in Examination.

B.Tech. (VI Sem.)

23ME18- ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

L	T	P	C
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PRE-REQUISITES: Linear Algebra, Probability, Statistics,

COURSE EDUCATIONAL OBJECTIVE:

This course introduces the fundamental concepts of Artificial Intelligence (AI), including knowledge representation and reasoning techniques. It covers key machine learning paradigms such as supervised and unsupervised learning, Bayesian algorithms, and neural networks. Students will also gain insights into genetic algorithms, machine learning analytics, and emerging deep learning techniques.

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

- **CO1:** Describe the fundamental concepts and techniques of artificial intelligence. **(Understanding – L2)**
- **CO2:** Apply the principles of supervised learning methods to solve classification and regression problems. **(Applying – L3)**
- **CO3:** Apply unsupervised learning techniques and Bayesian algorithms for data clustering and probabilistic inference. **(Applying – L3)**
- **CO4:** Apply neural networks and genetic algorithms to solve optimization and pattern recognition problems. **(Applying – L3)**
- **CO5:** Apply machine learning analytics and implement basic deep learning techniques for real-world applications**. (Applying – L3)**

UNIT– I: INTRODUCTION TO ARTIFICIAL INTELLIGENCE (AI)

INTRODUCTION: Definition of Artificial Intelligence, Evolution, Need, and applications in real world. Intelligent Agents, Agents and Environments; Good Behaviour - concept of rationality, the nature of environments, structure of agents.

KNOWLEDGE–REPRESENTATION AND REASONING: Logical Agents: Knowledge-based agents, the Wumpus world, logic. Patterns in Propositional Logic, Inference in First-Order Logic-Propositional vs first order inference, unification.

UNIT– II: INTRODUCTION TO MAHCINE LEARNING (ML)

INTRODUCTION TO MACHINE LEARNING (ML): Definition, Evolution, Need, applications of ML in industry and real-world, regression and classification problems, performance metrics, differences between supervised and unsupervised learning paradigms, bias, variance, overfitting and under fitting.

SUPERVISED LEARNING: Linear regression, logistic regression, Distance-based methods, Nearest-Neighbours, Decision Trees, Support Vector Machines, Nonlinearity and Kernel Methods.

UNIT– III: UNSUPERVISED LEARNING

UNSUPERVISED LEARNING: Clustering**,** K-means, Dimensionality Reduction, PCA and Kernel.

BAYESIAN AND COMPUTATIONAL LEARNING: Bayes theorem, concept learning, maximum likelihood of normal, binomial, exponential, and Poisson distributions, minimum

description length principle, Naïve Bayes Classifier, Instance-based Learning- K-Nearest neighbour learning.

UNIT– IV: NEURAL NETWORKS AND GENTIC ALGORITHMS

NEURAL NETWORKS AND GENETIC ALGORITHMS: Neural network representation, problems, perceptron, multilayer networks and backpropagation, steepest descent method, Convolutional neural networks and their applications Recurrent Neural Networks and their applications, Local vs Global optima, Genetic algorithms- binary coded GA, operators, convergence criteria.

UNIT– V: DEEP LEARNING AND ML ALGORITHM ANALYTICS

DEEP LEARNING: Deep generative models, Deep Boltzmann Machines, Deep auto-encoders, Applications of Deep Networks.

MACHINE LEARNING ALGORITHM ANALYTICS: Evaluating Machine Learning algorithms, Model, Selection, Ensemble Methods - Boosting, Bagging, and Random Forests.

TEXT BOOKS:

1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 2/e, Pearson Education, 2010.
2. Tom M. Mitchell, Machine Learning, McGraw Hill, 2013.
3. Ethem Alpaydin, Introduction to Machine Learning (Adaptive Computation and Machine Learning), The MIT Press, 2004.
4. Deisenroth, Faisal, Ong, Mathematics for Machine Learning, Cambridge University Press, 2020.
5. B Joshi, Machine Learning and Artificial Intelligence, Springer, 2020.
6. Parag Kulkarni and Prachi Joshi, "Artificial Intelligence – Building Intelligent Systems", PHI learning Pvt. Ltd., ISBN – 978-81-203-5046-5, 2015

REFERENCE BOOKS:

1. Elaine Rich, Kevin Knight and Shivashankar B. Nair, Artificial Intelligence, 3/e, McGraw Hill Education, 2008.
2. Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems, PHI Learning, 2012.
3. Solanki, Kumar, Nayyar, Emerging Trends and Applications of Machine Learning, IGI Global, 2018.
4. Mohri, Rostamizdeh, Talwalkar, Foundations of Machine Learning, MIT Press, 2018
5. Kumar, Zindani, Davim, Artificial Intelligence in Mechanical and Industrial Engineering, CRC Press, 2021.
6. Zsolt Nagy - Artificial Intelligence and Machine Learning Fundamentals-Apress (2018)
7. Artificial Intelligence by Elaine Rich, Kevin Knight and Nair, TMH

ONLINE RESOURCES:

https://www.tpointtech.com/artificial-intelligence-ai
https://www.geeksforgeeks.org/

L	T	P	C
3	0	0	3

B.Tech. (VI Sem.) **23ME19- FINITE ELEMENT METHODS**

PRE-REQUISITES: Mechanics of Solids, Heat Transfer.

COURSE EDUCATIONAL OBJECTIVE:

The main objective of this course is to understand the principles of finite elements and to develop finite models for engineering applications.

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

- **CO1:** Formulate the equilibrium equations for solving static engineering problems. **(Applying-L3)**
- **CO2:** Analyze structural behavior of Plane Truss Elements. **(Analyzing-L4)**
- **CO3:** Compute the characteristics of flexural elements under different loading conditions. **(Applying-L3)**
- **CO4:** Analyze 2-D structures with iso-parametric elements along with Axi-symmetric problems. **(Analyzing-L4)**
- **CO5:** Apply finite element techniques to solve thermal problems and dynamic analysis of bar and beam elements. **(Applying-L3)**

UNIT – I

INTRODUCTION TO FINITE ELEMENT METHOD: Introduction to finite element method, Advantages and Disadvantages- Applications, Stress and Equilibrium, Strain-Displacement relations, Stress – strain relations, Plane stress and Plane strain conditions, Potential Energy approach.

ONE DIMENSIONAL PROBLEM: Bar element formulation, Discretization of domain, element shapes, discretization procedures, assembly of Global stiffness matrix, node numbering, mesh generation, interpolation functions, local and global coordinates, convergence requirements, treatment of boundary conditions.

UNIT – II

ANALYSIS OF TRUSSES: Finite element modeling, coordinates and shape functions, assembly of global stiffness matrix and load vector, finite element equations, treatment of boundary conditions, stress, strain and support reaction calculations.

UNIT – III

ANALYSIS OF BEAMS: Element stiffness matrix for Hermite beam element, derivation of load vector for concentrated and UDL, simple problems on beams.

UNIT – IV

CONSTANT STRAIN TRAINGLE: Finite element modelling of two-dimensional stress analysis with Constant Strain Triangles and treatment of boundary conditions.

AXISYMMETRIC LOADING: Finite element modelling of Axi-symmetric solids subjected to Axi-symmetric loading with triangular elements. Two dimensional four noded-isoparametric elements, problems with isoperimetric formulation of four noded- quadrilateral elements.

UNIT – V

STUDY STATE HEAT TRANSFER ANALYSIS: Heat conduction in plane walls, one dimensional analysis of a fin.

DYNAMIC ANALYSIS: Formulation of finite element model-Lumped and consistent mass matrices-Evaluation of eigen values and eigen vectors for a bar and beams, free vibration analysis.

TEXT BOOKS:

T1: Chandraputla, Ashok and Belegundu, Introduction to Finite Elements in Engineering, 6th edition, Prentice-Hall,2014.

T2: S.S Rao, The Finite Element Methods in Engineering 6th edition, B.H.Pergamon.2014.

REFERENCE BOOKS:

R1: SS Bhavikatti, Finite Element Analysis, New Age International Publishers 3rd edition 2005.

R2: JN. Reddy, An introduction to Finite Element Method, 3rd edition, Mc Graw Hill, 2011.

R3: George R. Buchanan and R. Rudra Moorthy, Finite Element Analysis, Tata Mc Graw Hill, 2006.

L	T	P	C
3	0	0	3

B.Tech. (VI Sem.) **23ME20- MECHANICAL VIBRATIONS**

PRE-REQUISITES: Engineering Mechanics, Mechanics of solids

COURSE EDUCATIONAL OBJECTIVE:

The main objective of this course is to provide the knowledge of mathematical modeling of various degrees of freedom of systems under free and forced vibrations and also familiarize the systems to study the response.

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

- **CO1:** Formulate the governing equations for single degree of freedom vibrating systems. **(Applying - L3)**
- **CO2:** Calculate the damped parameters of single-degree of freedom of systems subjected to free vibrations. **(Applying - L3)**
- **CO3:** Analyze the multi degree of freedom systems to find the response by using different methods. **(Analyzing - L4)**
- **CO4:** Analyze and determine the natural frequencies and modes of torsional, longitudinal, and transverse vibrations in continuous systems. **(Analyzing - L4)**
- **CO5:** Comprehend the various vibration measuring instruments**. (Understanding - L2)**

UNIT – I

INTRODUCTION AND SINGLE DEGREE OF FREEDOM UNDAMPED SYSTEMS:

Relevance of and need for vibrational analysis – Basics of SHM - Mathematical modelling of vibrating systems - Discrete and continuous systems -Governing equation single degree of freedom Systems for undamped systems - free and forced vibrations**.**

UNIT – II

SINGLE DEGREE OF FREEDOM DAMPING SYSTEMS:

Introduction – Types of damping – Free vibrations with viscous damping – Over damped, critically damped and under damped systems –Damping ratio, Logarithmic decrement – Viscous dampers, slosh dampers.

UNIT – III

MULTI-DEGREE OF FREEDOM SYSTEMS:

Free and forced vibrations of multi-degree freedom systems in longitudinal, torsional and lateral modes - Matrix methods of solution- normal modes - Orthogonality principle-Energy methods, Eigen values and Eigen vectors, modal analysis.

UNIT – IV

VIBRATIONS IN CONTINOUS SYSTEMS:

Torsional vibrations - Longitudinal vibration of rods - transverse vibrations of beams – Governing equations of motion - Natural frequencies and normal modes - Energy methods, Introduction to non-linear and random vibrations.

UNIT – V

VIBRATION MEASUREMENT AND CRITICAL SPEEDS OF SHAFTS:

Vibration Measuring Instruments and Critical Speeds of Shafts: Vibrometers, Accelerometer, Frequency measuring instruments and Problems. Critical speed of a light shaft having a single disc without damping and with damping,

TEXT BOOKS:

T1 G.K.Grover, Mechanical vibrations, 8th edition, Nemchand & Bros.2018

T2 W.T.Thomson, Theory of vibrations, 3rd edition, CBS Publications & Distributors, 1999.

REFERENCE BOOKS:

R1 William W.Setio, Mechanical vibrations, Schaum outline series, 1964.

R2 V.P.Singh, Mechanical vibrations, 3rd edition, DhanpatRai& Sons, 2001.

R3 S.S.Rao, Mechanical Vibrations, Pearson Education, 2004.

B.Tech. (VI Sem.)

23ME21- ADVANCED MANUFACTURING PROCESSES

L	T	P	C
3	0	0	3

PRE-REQUISITES: Manufacturing processes, Machine Tools and Metrology

COURSE EDUCATIONAL OBJECTIVES:

This course aims to provide students with foundational knowledge of advanced machining and additive manufacturing processes. It covers the principles of surface coating, ceramic processing, and the handling of composites and nanomaterials. Additionally, students will gain insights into the fabrication techniques used in microelectronic component manufacturing.

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

- **CO1:** Understand the principles of advanced machining processes such as AJM, EDM, ECM, and laser-based methods to select suitable techniques for specific applications. **(Understanding – L2)**
- **CO2:** Demonstrate the working principles and applications of various additive manufacturing techniques, including rapid tooling methods. **(Understanding – L2)**
- **CO3:** Apply surface treatment techniques and laser-based material processing methods for coating and modification of engineering surfaces. **(Applying – L3)**
- **CO4:** Explain advanced coating processes such as PVD, CVD, thermal spraying, and nanomaterial synthesis techniques for surface enhancement. **(Understanding – L2)**
- **CO5:** Describe the fabrication steps involved in microelectronic device manufacturing, including lithography, film deposition, and packaging. **(Understanding – L2)**

UNIT – I: INTRODUCTION TO ADVANCED MACHINING PROCESSES

ADVANCED MACHINING PROCESSES: Introduction, Need, AJM, WJM, EDM, Wire-EDM, ECM, LBM, EBM, PAM – Principle, working, advantages, limitations, Process Parameters & capabilities and applications.

UNIT – II: ADDITIVE MANUFACTURING

ADDITIVE MANUFACTURING: Working Principles, Methods, Stereo Lithography, LENS, LOM, Laser Sintering, Fused Deposition Method, 3DP Applications and Limitations

UNIT – III: SURFACE TREATMENT

SURFACE TREATMENT: Scope, Cleaners, Methods of cleaning, Surface coating types, Electro forming, Chemical vapour deposition, Physical vapour deposition, thermal spraying methods, Ion implantation, diffusion coating, ceramic and organic methods of coating, and cladding methods, Industrial Applications for Surface Treatment of Materials.

UNIT – IV: PROCESSING OF NANOMATERIALS

PROCESSING OF NANOMATERIALS: Introduction, Top down Vs Bottom up techniques-Ball milling, Lithography, Plasma Arc Discharge, Pulsed Laser Deposition, Sputtering, Sol-Gel.

UNIT – V: FABRICATION OF MICROELECTRONIC DEVICES

Crystal growth and wafer preparation, Film Deposition, oxidation, lithography, bonding and packaging, reliability and yield, Printed Circuit boards.

TEXT BOOKS:

1. Manufacturing Engineering and TechnologyIKalpakijian / Adisson Wesley, 1995.
2. Process and Materials of Manufacturing / R. A. Lindburg / 1th edition, PHI 1990.
3. Pandey P.C. and Shah H.S, Modern Machining Process / TMH.
4. Chua C.K, Leong K.F and Lim C.S, Rapid Prototyping principles and applications, second edition, world scientific publishers. 2003.

REFERENCES:

1. Microelectronic packaging handbook / Rao. R. Thummala and Eugene, J. Rymaszewski / Van Nostrand Renihold,
2. MEMS & Micro Systems Design and manufacture / Tai — Run Hsu / TMGH
3. Advanced Machining Processes / V.K.Jain / Allied Publications.
4. Introduction to Manufacturing Processes / John A ScheyIMcGraw Hill.
5. Introduction to Nanoscience and Nano Technology/ Chattopadhyay K.K/A.N.Banerjee/ PHI Learning
6. M.K.Singh, Unconventional Manufacturing Processes / New age international.
7. N.Hopkinson, R.J.M Haque &P.M.Dickens Rapid Manufacturing, John Wiley & Sons, 2006.

B.Tech. (VI Sem.)

23ME22- RENEWABLE ENERGY TECHNOLOGIES

L	T	P	C
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PRE-REQUISITES:

COURSE EDUCATIONAL OBJECTIVE:

To provide the insights on different renewable energy sources, potential, salient features and utilization of solar, wind, geothermal, ocean thermal energy, bio energy and fuel cell systems.

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

- **CO1:** Demonstrate the importance, the impact of solar radiation. **(Understanding-L2)**
- **CO2:** Understand the principles of solar PV modules and storage in PV systems. **(Understanding-L2)**
- **CO3:** Discuss solar energy storage systems and their applications. **(Understanding-L2)**
- **CO4:** Describe power extraction from wind and bio-mass. **(Understanding-L2)**
- **CO5:** Illustrate the working of geothermal, ocean energy and fuel cells. **(Understanding-L2)**

UNIT – I

SOLAR RADIATION: Role and potential of new and renewable sources, the solar energy option, Environmental impact of solar power, structure of the sun, the solar constant, sun-earth relationships, coordinate systems and coordinates of the sun, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data.

UNIT – II

SOLAR PV MODULES AND PV SYSTEMS: PV Module Circuit Diagram, Module Structure, Packing Density, Interconnections, Mismatch and Temperature Effects, Electrical and Mechanical Insulation, Lifetime of PV Modules, Degradation and Failure, PV Module Parameters, Efficiency of PV Module, Solar PV Systems. Battery Operation, Types of Batteries, Battery Parameters, Application and Selection of Batteries for Solar PV System,

UNIT – III

SOLAR ENERGY COLLECTION: Flat plate and concentrating collectors, classification of concentrating collectors, orientation.

SOLAR ENERGY STORAGE AND APPLICATIONS: Different methods, sensible, latent heat and stratified storage, solar ponds, solar applications- solar heating/cooling technique, solar distillation and drying, solar cookers, central power tower concept and solar chimney.

UNIT – IV

WIND ENERGY: Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz's criteria, types of winds, wind data measurement.

BIO-MASS: Principles of bio-conversion, anaerobic/aerobic digestion, types of bio-gas digesters, gas yield, Gasifiers, applications.

UNIT – V

GEOTHERMAL ENERGY: Origin, Applications, Types of Geothermal Resources, Geothermal power generation, Relative Merits and Demerits.

OCEAN ENERGY: Ocean Thermal Energy; Open Cycle & Closed Cycle OTEC Plants, Environmental Impacts, Challenges and applications.

GREEN ENERGY: Introduction, Fuel cells-Applications, Classification, Different Types of Fuel Cells Such as Phosphoric Acid Fuel Cell, Alkaline Fuel Cell, PEM Fuel Cell, MC Fuel Cell. Hydrogen- Zero energy Concepts. Benefits of hydrogen energy, hydrogen production technologies (electrolysis method only), hydrogen energy storage, applications of hydrogen energy, problem associated with hydrogen energy.

TEXT BOOKS:

1. Renewable Energy Technologies -Ramesh & Kumar /Narosa
2. Solar Energy – Principles of Thermal Collection and Storage/Sukhatme S.P. and J.K.Nayak/TMH
3. Non-conventional Energy Source- G.D Roy/Standard Publishers.

REFERENCES:

1. Non-Conventional Energy Resources- Khan B.H/ Tata McGraw Hill, New Delhi, 2006.
2. Non-Conventional Energy - Ashok V Desai /New Age International (P) Ltd
3. Non-conventional Energy Source- G S Sawhney- PHI, New Delhi, 2012.

B.Tech. (VI Sem.)	23ME23- SENSORS AND INSTRUMENTATION	L	T	P	C
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PRE-REQUISITES:

COURSE EDUCATIONAL OBJECTIVE:

This course aims to provide a clear understanding of measurement technology and the various sensors used to measure physical parameters. It covers the fundamentals of signal conditioning, data acquisition (DAQ), and communication systems essential for mechatronics system development. The course also includes detailed insights into optical, pressure, and temperature sensors, along with a comprehensive understanding of signal conditioning and DAQ systems

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

- **CO1:** Recognize with various calibration techniques and signal types for sensors. **(Remembering-L1)**
- **CO2:** Describe the working principle and characteristics of force, magnetic, heading, pressure and temperature, smart and other sensors and transducers. **(Understanding-L2)**
- **CO3:** Apply the various sensors and transducers in various applications. **(Applying-L3)**
- **CO4:** Select the appropriate sensor for different applications. **(Applying-L3)**
- **CO5:** Acquire the signals from different sensors using Data acquisition systems. **(Understanding-L2)**

UNIT I

INTRODUCTION: Basics of Measurement – Classification of errors – Error analysis – Static and dynamic characteristics of transducers – Performance measures of sensors – Classification of sensors – Sensor calibration techniques – Sensor Output Signal Types.

UNIT II

MOTION, PROXIMITY AND RANGING SENSORS: Motion Sensors – Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro – Microsyn, Accelerometer – GPS, Bluetooth, Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR).

UNIT III

FORCE, MAGNETIC AND HEADING SENSORS: Strain Gage, Load Cell, Magnetic Sensors – types, principle, requirement and advantages: Magneto resistive – Hall Effect – Current sensor Heading Sensors – Compass, Gyroscope, Inclinometers.

UNIT IV

OPTICAL, PRESSURE AND TEMPERATURE SENSORS: Photo conductive cell, photo voltaic, Photo resistive, LDR – Fiber optic sensors – Pressure – Diaphragm, Bellows, Piezoelectric – Tactile sensors, Temperature – IC, Thermistor, RTD, Thermocouple. Acoustic Sensors – flow and level measurement, Radiation Sensors - Smart Sensors - Film sensor, MEMS & Nano Sensors, LASER sensors.

UNIT V

SIGNAL CONDITIONING AND DAQ SYSTEMS: Amplification – Filtering – Sample and Hold circuits – Data Acquisition: Single channel and multi-channel data acquisition – Data logging - applications - Automobile, Aerospace, Home appliances, Manufacturing, Environmental monitoring.

TEXT BOOKS:

1. Ernest O Doebelin, "Measurement Systems – Applications and Design", Tata McGraw-Hill, 2009.
2. Sawney A K and Puneet Sawney, "A Course in Mechanical Measurements and Instrumentation and Control", Dhanpat Rai & Co, 12th edition New Delhi, 2013.

REFERENCES

1. C. Sujatha ... Dyer, S.A., Survey of Instrumentation and Measurement, John Wiley & Sons, Canada, 2001.
2. Hans Kurt Tönshoff (Editor), Ichiro, "Sensors in Manufacturing" Volume 1, Wiley-VCH April 2001.
3. John Turner and Martyn Hill, "Instrumentation for Engineers and Scientists", Oxford Science Publications, 1999.
4. Patranabis D, "Sensors and Transducers", 2nd Edition, PHI, New Delhi, 2011.
5. Richard Zurawski, "Industrial Communication Technology Handbook" 2nd edition, CRC Press, 2015.

B.Tech. (VI Sem.)

23ME24- ENERGY STORAGE TECHNOLOGIES

L	T	P	C
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PRE-REQUISITES:

COURSE EDUCATIONAL OBJECTIVE:

This course provides insights into the importance of energy storage systems and offers an in-depth understanding of chemical and electromagnetic storage technologies. It covers the principles of electrochemical storage systems and explains the working of advanced devices such as supercapacitors and fuel cells. Additionally, the course focuses on the design aspects of batteries for transportation applications, equipping students with the knowledge required for modern energy storage solutions.

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

CO1: Understand the importance of energy storage systems**(Undrestanding-L2)**

CO2: Describe the chemical and electromagnetic storage systems**(Undrestanding-L2)**

CO3: Understand the principles of electrochemical storage systems**(Undrestanding-L2)**

CO4: Comprehend the construction and working of super capacitors and fuel cells**(Undrestanding-L2)**

CO5: Demonstrate the key features of batteries used in transportation**(Undrestanding-L2)**

UNIT-I

ENERGY STORAGE SYSTEMS OVERVIEW: Scope of energy storage, needs and opportunities in energy storage, Technology overview and key disciplines, comparison of time scale of storages and applications, Energy storage in the power and transportation sectors. Importance of energy storage systems in electric vehicles, Current electric vehicle market. Thermal storage system-heat pumps, hot water storage tank, solar thermal collector, application of phase change materials for heat storage-organic and inorganic materials, efficiencies, and economic evaluation of thermal energy storage systems.

UNIT-II

CHEMICAL STORAGE SYSTEM: Hydrogen, methane etc., concept of chemical storage of solar energy, application of chemical energy storage system, advantages and limitations of chemical energy storage, challenges, and future prospects of chemical storage systems.

ELECTROMAGNETIC STORAGE SYSTEMS: Double layer capacitors with electrostatically charge storage, superconducting magnetic energy storage (SMES), concepts, advantages and limitations of electromagnetic energy storage systems, and future prospects of electrochemical storage systems.

UNIT-III

ELECTROCHEMICAL STORAGE SYSTEM: Batteries-Working principle of battery, primary and secondary (flow) batteries, battery performance evaluation methods, major battery chemistries and their voltages- Li-ion battery& Metal hydride battery vs lead-acid battery

UNIT-IV

SUPER CAPACITORS: Working principle of super capacitor, types of super capacitors, cycling and performance characteristics, difference between battery and super capacitors, Introduction to Hybrid electrochemical super capacitors

FUEL CELL: Operational principle of a fuel cell, types of fuel cells, hybrid fuel cell-battery systems, hybrid fuel cell-super capacitor systems.

UNIT-V

BATTERY DESIGN FOR TRANSPORTATION: Mechanical Design and Packaging of Battery, Packs for Electric Vehicles, Advanced Battery, Assisted Quick Charger for Electric Vehicles, Charging Optimization Methods for Lithium-Ion Batteries, Thermal run-away for battery systems, Thermal management of battery systems, State of Charge and State of Health Estimation Over the Battery Lifespan, Recycling of Batteries from Electric Vehicles.

TEXT BOOKS:

1. Frank S. Barnes and Jonah G. Levine, Large Energy Storage Systems Handbook (Mechanical and Aerospace Engineering Series), CRC press (2011)
2. Ralph Zito, Energy storage: A new approach, Wiley (2010)

REFERENCES:

1. Pistoia, Gianfranco, and Boryann Liaw. Behaviour of Lithium-Ion Batteries in Electric Vehicles: Battery Health, Performance, Safety, and Cost. Springer International Publishing AG, 2018.
2. Robert A. Huggins, Energy storage, Springer Science & Business Media (2010)

B.Tech. (VI Sem.)

23ME25- INDUSTRIAL HYDRAULICS AND PNEUMATICS

L	T	P	C
3	0	0	3

PRE-REQUISITES:

COURSE EDUCATIONAL OBJECTIVE:

This course aims to introduce the basic concepts of fluid power and provide a clear understanding of the functions and operation of key elements in hydraulic and pneumatic systems. It offers knowledge about the essential components and their roles within hydraulic and pneumatic circuits, while also explaining the operating principles and working mechanisms of various devices. Additionally, the course imparts practical insights into the procedures for installation, maintenance, and troubleshooting of hydraulic and pneumatic systems.

Course Outcomes: At the end of the course, student will be able to

- **CO1:** Illustrate the basic concepts of fluid power. **(Understanding-L2)**
- **CO2** Understand the functions of elements of Hydraulic and Pneumatic systems. **(Understanding-L2)**
- **CO3:** Analyze the functions of hydraulic and Pneumatic circuits. **(Analyzing-L4)**
- **CO4:** Illustrate the working of various hydraulic and pneumatic devices. **(Understanding-L2)**
- **CO5:** Interpret the procedure of installation, maintenance of hydraulic and pneumatic systems. **(Applying-L3)**

UNIT – I

FLUID POWER: Power transmission modes, hydraulic systems, pneumatic systems, laws governing fluid flow: Pascal's law, continuity equation, Bernoulli's theorem, Boyle's, Charles', Gay-Lussec' laws, flow through pipes - types, pressure drop in pipes, Working fluids used in hydraulic and pneumatic systems- types, ISO/BIS standards and designations, properties.

UNIT – II

HYDRAULIC AND PNEUMATIC ELEMENTS: Hydraulic pipes-Types, standards, designation methods and specifications, pressure ratings, applications and selection criteria, pumping theory, Hydraulic Pumps - types, construction, working principle, applications, selection criteria and comparison, hydraulic Actuators, Control valves, Accessories - their types, construction and working, pneumatic Pipes - materials, designations, standards, properties and piping layout, air compressors, Air receivers, air dryers, Air Filters, Regulators, Lubricators (FRL unit): their types, construction, working, specifications and selection criteria of following air preparation and conditioning elements, pneumatic Actuators and Control valves - types, construction, working, materials and specifications

UNIT – III

HYDRAULIC AND PNEUMATIC CIRCUITS:

ISO symbols used in hydraulic and pneumatic circuit, basic Hydraulic Circuits – types (such as intensifier, regenerative, synchronizing, sequencing, speed control, safety), circuit diagram, components, working and applications, basic Pneumatic Circuits – types (such as speed control, two step feed control, automatic cylinder reciprocation, time delay, quick exhaust), circuit diagram, components, working and applications, pneumatic Logic circuit design - classic method, cascade method, step counter method, Karnaugh- veitch maps and combinational circuit design.

UNIT – IV

HYDRAULIC AND PNEUMATIC DEVICES:

Hydraulic and Pneumatic devices – Concept and applications, construction, working principle, major elements, performance variables of: Automotive hydraulic brake, Industrial Fork lift, Hydraulic jack, Hydraulic press, Automotive power steering, Automotive pneumatic brake, Automotive air suspension, Pneumatic drill, Pneumatic gun.

UNIT – V

INSTALLATION, MAINTENANCE AND TROUBLE-SHOOTING:

Installation of hydraulic and pneumatic system causes and remedies for common troubles arising in hydraulic elements, maintenance of hydraulic systems, causes and remedies for troubles arising in pneumatic elements, maintenance of pneumatic systems.

TEXTBOOKS:

1. Majumdar, S.R. Oil Hydraulic Systems Tata McGraw-Hill Publication, New Delhi,3/e, 2013
2. Majumdar, S.R. Pneumatic Systems Tata McGraw-Hill Publication, New Delhi,3/e, 2013

REFERENCES:

1. Srinivasan, R. Hydraulic and Pneumatic Controls Vijay Nicole Imprints Private, New Delhi, Limited, 2/e, 2008
2. Jagadeesha, T. Fluid Power Generation, Transmission and Control Universities Press (India) Private Limited, New Delhi,1/e, 2014
3. Jagadeesha, T. Pneumatics Concepts, Design and Applications Universities Press (India) Private Limited, New Delhi,1/e, 2014
4. Parr, Andrew Hydraulic and Pneumatics, A Technician's and Engineer's Guide, Jaico Publishing House, New Delhi,2/e, 2013
5. Shanmuga Sundaram, K. Hydraulic and Pneumatics Controls - Understanding Made Easy S. Chand Company Ltd., New Delhi, 1/e, 2006

B.Tech. (VI Sem.)	23ME26- NON-DESTRUCTIVE EVALUATION	L	T	P	C
		3	0	0	3

PRE-REQUISITES: MANUFACTURING PROCESSES

COURSE EDUCATIONAL OBJECTIVE:

This course aims to provide students with a solid understanding of the basic principles and techniques used in non-destructive testing (NDT) and their industrial applications. It covers ultrasonic testing, liquid penetrant and eddy current methods, magnetic particle testing, and infrared/thermal testing. Students will learn the operating procedures, advantages, and limitations of each method to assess material integrity without causing damage.

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

CO1: Understand the concepts of various NDE techniques and the requirements of radiography techniques and safety aspects. **(Understanding-L2)**

CO2: Interpret the principles and procedure of ultrasonic testing. **(Understanding-L2)**

CO3: Understand the principles and procedure of Liquid penetration and eddy current testing. **(Understanding-L2)**

CO4: Illustrate the principles and procedure of Magnetic particle testing. **(Understanding-L2)**

CO5: Interpret the principles and procedure of infrared testing and thermal testing. **(Understanding-L2)**

UNIT– I: INTRODUCTION TO NON-DESTRUCTIVE TESTING

INTRODUCTION TO NON-DESTRUCTIVE TESTING AND INDUSTRIAL APPLICATIONS OF NDE: Span of NDE Activities Railways, Nuclear, Non-nuclear and Chemical Industries, Aircraft and Aerospace Industries, Automotive Industries, Offshore Gas and Petroleum Projects, Coal Mining Industry, NDE of pressure vessels, castings, welded constructions. Radiographic test, Sources of X and Gamma Rays and their interaction with Matter, Radiographic equipment, Radiographic Techniques, Safety Aspects of Industrial Radiography, neutron ray radiography

UNIT– II: ULTRASONIC TEST

ULTRASONIC TEST: Principle of Wave Propagation, Reflection, Refraction, Diffraction, Mode Conversion and Attenuation, Sound Field, Piezo-electric Effect, Ultrasonic Transducers and their Characteristics, Ultrasonic Equipment and Variables Affecting Ultrasonic Test, Ultrasonic Testing, Interpretations and Guidelines for Acceptance, Rejection - Effectiveness and Limitations of Ultrasonic Testing.

UNIT– III: LIQUID PENETRANT TES

LIQUID PENETRANT TEST: Liquid Penetrant Test, Basic Concepts, Liquid Penetrant System, Test Procedure, Effectiveness, DPI, FPI, Limitations of Liquid Penetrant Testing. Eddy Current Test: Principle of Eddy Current, Eddy Current Test System, Applications of Eddy Current Testing Effectiveness of Eddy Current Testing

UNIT– IV: MAGNETIC PARTICLE TEST

MAGNETIC PARTICLE TEST: Magnetic Materials, Magnetization of Materials, Demagnetization of Materials, Principle of Magnetic Particle Test, Magnetic Particle Test Equipment, Magnetic Particle Test Procedure, Standardization and Calibration, Interpretation and Evaluation, Effective Applications and Limitations of the Magnetic Particle Test

UNIT– V: INFRARED AND THERMAL TESTING

INFRARED AND THERMAL TESTING: Introduction and fundamentals to infrared and thermal testing–Heat transfer –Active and passive techniques –Lock in and pulse thermography, tomography-Contact and non-contact thermal inspection methods–Heat sensitive paints –Heat sensitive papers –-thermally quenched phosphors liquid crystals –techniques for applying liquid crystals –other temperature sensitive coatings –Inspection methods –Infrared radiation and infrared detectors–thermo mechanical behaviour of materials–IR imaging in aerospace applications, electronic components, Honey comb and sandwich structures–Case studies.

TEXTBOOKS:

1. Nondestructive test and evaluation of Materials/J Prasad, GCK Nair/TMH Publishers
2. Ultrasonic testing of materials/ H Kraut Kramer/Springer
3. Nondestructive testing/Warren, J Mc Gonnagle / Godan and Breach Science publishers
4. Nondestructive evaluation of materials by infrared thermography / X. P. V. Maldague, Springer-Verlag, 1st edition, (1993)

REFERENCES:

1. Ultrasonic inspection training for NDT/E.A.Gingel/PrometheusPress,
2. ASTMStandards,Vol3.01, Metalsandalloys
3. Non-destructive, Hand Book – R. HamChand

B.Tech. (VI Sem.)

23ME27- REFRIGERATION & AIR-CONDITIONING

L	T	P	C
3	0	0	3

PRE-REQUISITES: Thermodynamics.

COURSE EDUCATIONAL OBJECTIVE:

This course provides insights of refrigeration and air conditioning fundamentals. It covers the different refrigeration cycles and its analysis and also the concepts of psychrometry and psychrometry process used for the purpose of air conditioning. Further, the comfort air conditioning and cooling load design and estimation also addressed in this course.

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

- **CO1:** Describe the basic concepts of refrigeration and its applications. **(Understanding-L2)**
- **CO2:** Evaluate the performance parameters of refrigeration systems. **(Applying-L3)**
- **CO3:** Identify the desirable refrigerants and its use in various refrigeration systems. **(Remembering-L1)**
- **CO4:** Analyze the psychrometric properties and processes used in Air Conditioning systems. **(Analysing-L4)**
- **CO5:** Design of Air Conditioning systems for thermal comfort conditions. **(Designing-L5)**

UNIT - I

FUNDAMENTALS OF REFRIGERATION: Introduction- Necessity and applications, unit of refrigeration and C.O.P-Heat Engine, Refrigerator and Heat pump-Types of Refrigeration systems, and its applications.

REFRIGERANTS: Classification of refrigerants- Desirable Properties-Nomenclature-Commonly used refrigerants- Alternate refrigerants –Green house effect, global warming, and Ozone layer depletion and Global warming potential.

AIR REFRIGERATION SYSTEM: Introduction-Air refrigeration system working on Reversed Carnot cycle – Air refrigeration system working on Bell Coleman cycle- COP- Open and Dense air systems, Applications.

UNIT - II

VAPOUR COMPRESSION REFRIGERATION SYSTEM: Working principle-Simple vapour compression refrigeration cycle – COP- Representation of cycle on T-s and P-h charts- Effect of Sub cooling and Superheating --Actual Vapour compression cycle and its applications

VCR SYSTEM COMPONENTS: Compressors-Classification-Working -Condensers – Classification-Working-Evaporators –Classification-Working, Expansion devices –Types-Working.

UNIT - III

VAPOUR ABSORPTION REFRIGERATION SYSTEM: Description and working of Aqua-Ammonia system- Calculation of maximum COP- Lithium Bromide- Water system-Principle of operation of three fluid absorption systems, Applications.

STEAM JET REFRIGERATION SYSTEM: Principle of working –Analysis- Applications.

NON-CONVENTIONAL REFRIGERATION SYSTEMS- Thermo electric Refrigeration, Vortex tube refrigeration, Adiabatic demagnetization Refrigeration.

UNIT - IV

PSYCHROMETRY: Introduction - Psychrometric properties and relations- Psychrometric chart Psychrometric processes-Sensible, Latent and Total heat–Sensible Heat Factor and Bypass Factor.
HUMAN COMFORT: Thermodynamics of Human body-Effective temperature – Comfort chart.

UNIT - V

AIR CONDITIONING SYSTEMS: Introduction-Components of Air conditioning system-Classification of Air conditioning systems- filters, grills and registers, fans and blowers. Central and Unitary systems- Packaged air conditioning systems-summer, winter and Year-round systems-comfort air conditioning – requirements of industrial air conditioning. Cooling load estimation.
DESIGN OF AIR CONDITIONING SYSTEMS: Summer air conditioning –ADP-System with Ventilated and re-circulated air with and without bypass factor- RSHF, GSHF and ESHF and Infiltration design conditions.

NOTE: Refrigerants &Psychrometric properties- by M.L. Mathur& F.S. Mehta data book will be supplied in the exam hall.

TEXT BOOKS

1. C. P. Arora. , Refrigeration and air conditioning - TMH, 2nd Edition, 2000.
2. R. Dossat, Principles of Refrigeration - - Pearson 4th Edition 2001

REFERENCES

1. S. C. Arora, Domkundwar, A course in refrigeration and air conditioning-Dhanapat Rai& sons 5th Edition 1997.
2. Manohar Prasad, Refrigeration and Air conditioning, New Age international, 2003
3. Wilbert F.Stoecker, Jerold W. J.Jones, MGH, 1986.

L	T	P	C
0	0	3	1.5

B.Tech. (VI Sem.) **23ME60-HEAT TRANSFER LAB**

PRE-REQUISITES: Thermodynamics

COURSE EDUCATIONAL OBJECTIVE:

The objective of this laboratory course is to gain hands on experience on the modes of heat transfer in various heat transfer equipment's used for different applications by conducting experiments.

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

CO1: Estimate the thermal conductivity of different materials and powders. **(Applying-L3)**

CO2: Compute the value of heat transfer coefficients in free and forced convection using data handbook. **(Applying-L3)**

CO3: Determine the emissivity of grey body. **(Applying-L3)**

CO4: Compare the LMTD, NTU parameters in parallel and counter flow heat exchangers. **(Analyzing-L4).**

LIST OF EXPERIMENTS

(At least 10 Experiments are required to be conducted)

1. Determine the thermal conductivity of given lagged pipe.
2. Determine the thermal conductivity of given Concentric Sphere
3. Find the thermal Conductivity of given metal rod.
4. Test on pin-fin apparatus to find the efficiency and effectiveness.
5. Determine the heat transfer rate in transient heat conduction
6. Find the heat transfer coefficient in forced convection apparatus.
7. Find the heat transfer coefficient in natural convection
8. Determine the LMTD and Effectiveness in Parallel and counter flow heat exchanger.
9. Find the emissivity of a grey surface.
10. Compare the rate of heat transfer in given pipe materials.
11. Study of Heat transfer in forced convection.
12. Evaluate the thermal conductivity of liquids.

REFERENCES

- Lab Manuals

Data Hand Book:

- C.P. Kothandaraman and Subramanian, Heat and Mass Transfer Data Book, New Age International Publications, 7th Edition, Reprint 2012

NOTE: Heat and Mass Transfer Data Hand Book by C.P. Kothandaraman and Subramanian- New Age Publications is to be allowed in Examination.

B.Tech. (VI Sem.)	23ME61-ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING LAB	L	T	P	C
		0	0	3	1.5

PRE-REQUISITES: Python Programming

COURSE EDUCATIONAL OBJECTIVE:

Students will acquire the knowledge of artificial intelligence and machine learning models using various software tools.

COURSE OUTCOMES: Students at the end of the course will be able to

- **CO1:** Learn various Python libraries. **(Understanding-L2)**
- **CO2:** Do programming for regression methods. **(Applying-L3)**
- **CO3:** Write coding for different types of neural networks. **(Applying-L3)**
- **CO4:** Write a program for decision tree, Naïve Bayes and SVM and generate code for autoencoders. **(Applying-L3)**

LIST OF EXPERIMENTS (ARTIFICIAL INTELLIGENCE):

Python Libraries required: Sklearn

Note: Standard datasets can be downloaded from UCI Machine Learning Repository (https://archive.ics.uci.edu/ml/datasets.php)

1. Learning of Python libraries – Numpy, Pandas, Matplotlib, Seaborn and TensorFlow
2. Numerical examples on Python libraries
3. Data Preprocessing and data cleaning using Python
4. Write a program for Linear regression
5. Write a program for Logistic regression
6. Write a program for ANN
7. Write a program for CNN
8. Write a program for RNN
9. Write a program to build a Decision tree
10. Write a program to build a Naïve Bayes classifier
11. Write a program for SVM
12. Write a program for Auto-encoder

REFERENCES: Lab Manual

B.Tech. (VI Sem.)

23MES3-ROBOTICS AND DRONE TECHNOLOGIES LAB

L	T	P	C
0	0	4	2

PRE-REQUISITES: Robotics, Mechatronics

COURSE OBJECTIVE: Robotics and Drone Technologies Laboratory offers the students hands-on experience in robotics, and unmanned aerial systems.

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

- **CO1:** Build and program basic robotic systems using sensors, actuators, and microcontrollers to perform navigation and object manipulation tasks. **(Applying – L3)**
- **CO2:** Simulate and analyze the kinematics and control of robotic manipulators using modeling and software tools. **(Analyzing – L4)**
- **CO3:** Demonstrate the working principles of drone components and control mechanisms such as roll, pitch, and yaw using appropriate sensor feedback. **(Applying – L3)**
- **CO4:** Design and assemble functional drone prototypes with capabilities such as video capture, obstacle avoidance, and payload handling. **(Applying – L3)**

List of Experiments:

ROBOTICS:

1) Simulation of Mathematical Model of Robot.
2) Forward and Inverse Dynamic Analysis of a 2-DOF Robotic Manipulator using Software Tools.
3) Building and Programming a Simple Arduino-Based Robot for basic movement.
4) Build a robot that can navigate through a maze or an environment by using sensors to detect obstacles and avoid them.
5) Construct a robotic arm using servo motors or stepper motors and program the arm to perform various tasks, such as picking up objects, sorting the colour, or drawing shapes.
6) Build a robot that follows a black line on a contrasting surface using line-following sensors.
7) Designing a 3D Model of a Robotic Arm and Grippers Using Software
8) Implement a PID controller for a robotic arm or mobile robot and simulate its performance in tracking a desired trajectory.

DRONE TECHNOLOGIES:

1. Demonstration of parts and functions of a drone.
2. Demonstration of effects of forces, manoeuvres of a drone by roll, pitch and yaw.
3. Demonstration of various sensors and battery management used in drones.
4. Build a prototype drone to record videos and photos.
5. Make a drone for a certain payload.

Students need to refer to the following links:

1. **https://aim.gov.in/pdf/equipment-manual-pdf.pdf**
2. **https://atl.aim.gov.in/ATL-Equipment-Manual/**
3. **https://aim.gov.in/pdf/Level-1.pdf**
4. **https://aim.gov.in/pdf/Level-2.pdf**
5. **https://aim.gov.in/pdf/Level-3.pdf**
6. **https://aim.gov.in/pdf/ATL_Drone_Module.pdf**

TEXT BOOKS: Lab Manual

B.Tech. (VI Sem.)

23MC04-TECHNICAL PAPER WRITING AND IPR

L	T	P	C
2	0	0	0

PRE-REQUISITES:

COURSE EDUCATIONAL OBJECTIVE:

This course is designed to help students understand the structure and key components of a technical paper, along with developing the skills necessary for literature review and writing a paper for initial submission. It also covers the process of Intellectual Property Rights (IPR) development, creates awareness about the scope and significance of patent rights, and provides insights into the latest advancements in IPR, including emerging software tools and technologies.

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

- **CO1:** Understand the structure of the technical paper and its components. **(Understanding-L2)**
- **CO2:** Review the literature and acquire the skills to write a technical paper for first submission. **(Understanding-L2)**
- **CO3:** Understand the process and development of IPR. **(Understanding-L2)**
- **CO4:** Create awareness about the scope of patent rights. **(Understanding-L2)**
- **CO5:** Analyze the new developments in IPR include latest software. **(Analyzing-L4)**

UNIT-I: PLANNING AND PREPARATION

Planning and Preparation, Word Order, breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness. Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction.

UNIT-II: LITERATURE REVIEW

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

Key skills needed when writing a Title, Abstract, Introduction, a Review of the Literature, the Methods, the Results, the Discussion, and the Conclusions. Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

UNIT-III: PROCESS AND DEVELOPMENT

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, patenting under PCT.

UNIT-IV: PATENT RIGHTS

Scope of Patent Rights. Licensing and transfer of technology, Patent information and databases, Geographical Indications.

UNIT-V: NEW DEVELOPMENTS IN IPR

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies.

TEXT BOOKS:

1. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press.
2. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.

REFERENCES:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book.
3. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011
4. Mayall, "Industrial Design", McGraw Hill, 1992.
5. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age" 2016.
6. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008.