

HYDERABAD INSTITUTE OF TECHNOLOGY AND MANAGEMENT						
B.TECH. HR-22 COURSE STRUCTURE						
MECHANICAL ENGINEERING						
(Applicable for the batch admitted from 2022-23 onwards)						
III-Semester (2 Year)						
S. No.	Course code	Course title	Hours Per Week			Credits
			L	T	P	
1	22ES3EE19	Basic Electrical & Electronics Engineering	3	0	0	3
2	22PC3ME01	Mechanics of Solids	3	0	0	3
3	22PC3ME02	Thermodynamics	3	1	0	4
4	22PC3ME03	Material Science & Metallurgy	3	0	0	3
5	22PC3ME04	Production Technology	3	0	0	3
6	22PC3ME05	Material Science & Mechanics of Solids Lab	0	0	2	1
7	22PC3ME06	Production Technology Lab	0	0	2	1
8	22ES3EE20	Basic Electrical & Electronics Engineering Lab	0	0	2	1
9	22PR3ME01	Evaluation of Internship-1	0	0	2	1
<b>TOTAL</b>			<b>15</b>	<b>1</b>	<b>8</b>	<b>20</b>
Non Credit Courses						
<u>12</u>	22MC3HS03	Universal Human Values	2	0	0	0
IV-Semester (2 Year)						
S. No.	Course code	Course title	Hours Per Week			Credits
			L	T	P	
<u>1</u>	22BS4MT03	Statistical Methods and Complex Variables	3	1	0	4
<u>2</u>	22PC4ME07	Kinematics of Machinery	3	0	0	3
<u>3</u>	22PC4ME08	IC Engines & Gas Turbines	3	0	0	3
<u>4</u>	22PC4ME09	Fluid Mechanics & Hydraulic Machinery	3	0	0	3
<u>5</u>	22HS4MB01	Business Economics and Financial Analysis	2	0	0	2
<u>6</u>	22PC4ME10	Computer Aided Machine Drawing Practice	0	0	2	1
<u>7</u>	22PC4ME11	Fluid Mechanics & Hydraulic Machinery Lab	0	0	2	1
<u>8</u>	22HS4EG03	English for Employability Lab	0	1	2	2
<u>9</u>	22PR4ME02	<b>Doing Engineering-1</b>	0	0	2	1
<b>TOTAL</b>			<b>14</b>	<b>2</b>	<b>8</b>	<b>20</b>
10	22MC4HS07	Constitution of India	0	1	0	0

**HR22**

**HITAM**

**B.Tech II Year – III Sem**

**L T P C**

**Subject Code: 22ES3EE01**

**3 0 0 3**

## **Basic Electrical & Electronics Engineering**

**Pre-requisite: Basic Mathematics & Physics**

### **Course Objectives:**

- 1) To introduce the concepts of electrical circuits and their components
- 2) To understand DC circuits and AC single-phase & three-phase circuits
- 3) To study and understand the different types of AC machines.
- 4) To introduce the concept of power, power factor and its improvement.
- 5) To introduce the concepts of diodes & transistors.

### **Module I: D.C. Circuits**

Electrical circuit elements (R, L and C), voltage and current sources, KVL&KCL, Mesh and Nodal analysis, Voltage and current divide rule, source transformation technique and star delta conversion, analysis of simple circuits with dc excitation. Superposition, Thevenin's, Norton's theorems with problems.

### **Module II: A.C. Circuits**

Representation of sinusoidal waveforms, Average and rms values, peak factor and Formfactor. Real power, Reactive power, Apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series). Resonance in series RLC circuits. Three-phase balanced circuits, voltage and current relations in star and delta connections.

### **Module III: Electrical Machines**

Construction and working principle of DC generators, EMF equation, working principle of DC motors, Back EMF. Single Phase Transformers: Working principle of Single-phase transformer, EMF equation, losses in transformers, efficiency, Three-phase transformer connections. Three Phase Induction motors - Principle of operation, slip, slip -torque characteristics.

### **Module IV: Diodes & Rectifiers**

Principle of Operation of Diode, Volt-Ampere characteristics, Zener diode characteristics, applications. P-N junction as a rectifier - Half Wave Rectifier, Ripple Factor, Full Wave Rectifier, Bridge Rectifier.

### **Module V: TRANSISTORS**

Construction, Principle of Operation, Current amplification factor, Transistor as amplifier. MOSFET, Input – output characteristics.

**TEXT BOOKS:**

1. Basic Electrical and electronics Engineering –M S Sukija TK Nagasarkar Oxford University
2. Basic Electrical and electronics Engineering-D P Ko

thari. I J Nagarath, McGraw Hill Education

**REFERENCE BOOKS:**

1. Electronic Devices and Circuits – R. L. Boylestad and Louis Nashelsky, PEI/PHI, 9th Ed, 2006. 2. Millman's Electronic Devices and Circuits – J. Millman and C. C. Halkias, Satyabrata Jit, TMH, 2/e, 1998.
2. Engineering circuit analysis- by William Hayt and Jack E. Kemmerly, McGraw Hill Company, 6th edition.
3. Electrical and Electronics Technology, E. Hughes, 10th Edition, Pearson, 2010 5. Electrical Engineering Fundamentals, Vincent Deltoro, Second Edition, Prentice Hall India, 1989.
4. Network Theory by Sudhakar, Shyam Mohan Palli, TMH.
5. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.

**Web Resources:**

1. <https://nptel.ac.in/courses/108/104/108104139/>
2. <https://nptel.ac.in/courses/117/103/117103063/>

**E- Books:**

1. [https://www.academia.edu/42933156/Basic\\_Electrical\\_Engineering\\_VK\\_Mehta](https://www.academia.edu/42933156/Basic_Electrical_Engineering_VK_Mehta)
2. [https://www.opentextbooks.org.hk/system/files/export/9/9648/pdf/Fundamentals\\_of\\_Electrical\\_Engineering\\_I\\_9648.pdf](https://www.opentextbooks.org.hk/system/files/export/9/9648/pdf/Fundamentals_of_Electrical_Engineering_I_9648.pdf)

**Course Outcomes:**

- CO1 – To analyze the electrical circuits with DC excitation.
- CO2 – To analyze electrical circuits with AC excitation
- CO3 – To Explain the working principles of electrical machines
- CO4 – To Analyze the characteristics of Electronic devices like diodes and transistors



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B. Tech II Year–III Sem

L T P C

Subject Code: 22PC3ME01

3 0 0 3

## MECHANICS OF SOLIDS

**Pre-requisites:** Engineering Physics & Engineering Mathematics.

### Course Objectives:

1. To learn the fundamental concepts of stress, strain, and deformation of solids with applications to bars, beams, and columns
2. Detailed study of engineering properties of materials is also of interest.
3. Fundamentals of applying equilibrium, compatibility, and force deformation relationships to structural elements are emphasized.
4. The students are introduced to advanced concepts of flexibility and stiffness method of structural analysis

### Module I

#### Introduction to stresses and strains

Basic of Stress & Strain, elastic constants, Properties of material stress – strain diagram, Hooke's law, Poisson's ratio, shear stresses, stresses in the components subjected to multi-axial forces, principal of superposition, Stresses in Combined structure, thermal stresses, statically indeterminate systems.

#### Principal stresses and strains:

Transformation of plane stresses, Principal stresses, Maximum shear stresses, Mohr's circle for plane stresses, Plain strain and its Mohr's circle representation, Principal strains, Maximum shear strain.

### Module II

#### Shear Force and Bending Moment:

Introduction of Beams, Various type of Beams, Various type of Supports, Reactions at supports, Shear force and bending moment at any section of a beam, Methods for determination of S.F. and B.M. diagrams of beams (simply supported, overhang and cantilever) subjected to various loads, Relation between Shear Force and Bending Moment, Point of contra-flexure.

#### Bending of beams

Bending of beams with symmetric section, boundary conditions, pure bending, and bending equation. Problems of simple bending, Transverse Shear stress.

### Module III

**Deflection of beams**-Relation between slope deflection and radius of curvature, solution of beam deflection, direct integration method, problem by Macaulay's method, Castigliano's method.

**Columns**-Struts and Columns, Stability of columns, Euler's formula for different end conditions, Equivalent load, Eccentric loading, Rankine's formula.

**Module IV**

**Torsion** Deformation in circular shaft due to torsion, basic assumptions, torsion equations, stresses in elastic range, angular deflection, hollow & stepped circular shaft.

**Strain Energy** Introduction, Strain energy, Proof Resilience, Elastic strain energy in tension, compression, bending and torsion. Impact loading in tension and bending.

**Module V**

**Combined Loading** on shafts and **failure theories**: Components subjected to bending, torsion & axial loads. Theories of failure.

**Thin Cylinders**: Thin seamless cylindrical shells – longitudinal and circumferential stresses. Thin spherical shells.

**Text Books:**

1. Strength of Materials – by R.K. Rajput, 6<sup>th</sup> Edition S Chand Publication, January 2015
2. Strength of Material – Dr. Sadhu Singh – 7<sup>th</sup> Edition Khanna Publishers 2017.
3. Strength of Materials by Andrew Pytel and Ferdinand L. Singer Longman.

**Reference Books:**

1. Mechanics of Material-Gere and Timoshenko 2<sup>nd</sup> Edition CBS Publications 2004
2. Mechanics of Material – F.P. Bear & E.E. Johnston – 8<sup>th</sup> Edition McGraw Hill, 2020
3. Engineering Mechanics of Solids –E.P. Popov –2<sup>nd</sup> Edition PHI, 1999

**Online references:**

<https://nptel.ac.in/courses/112/102/112102284/>

<https://www.openlearning.com/courses/mechanics-of-solids/?cl=1>

**Course Outcomes:** At the end of the course the student should be able to

- CO1 –Apply the concept of stress and strain to analyze various types of structures.
- CO2 – Determine the distribution of shear force, bending moment and transverse shear stress along the loaded beam
- CO3 – Analyze shaft under torsional load and various structural elements subjected to combine stresses/combined loads.
- CO4 – Determine the deflections and slope of loaded flexural members and columns



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B. Tech II Year–III Sem

L T P C

Subject Code: 22PC3ME02

3 1 0 4

## THERMODYNAMICS

**Pre-requisite:** Engineering Chemistry, Mathematics and Physics.

### Course Objectives:

To understand the treatment of classical Thermodynamics and to apply the First and Second laws of Thermodynamics to engineering applications.

[Tables/Codes: **Steam Tables and Mollier Chart, Psychrometric chart (Permitted to use in examinations)**]

### Module I

#### Fundamental Concepts and Definitions

System, Control Volume, Surrounding, Boundaries, Universe, Types of Systems, Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic Equilibrium, State, Property, Process, Cycle, Quasi –static Process,

#### Heat and Work

Energy in State and in Transition, Types, Displacement & Other forms of Work, Heat, Point and Path functions, Exact & Inexact Differentials, Zeroth Law of Thermodynamics – Concept of Temperature – Principles of Thermometry – Reference Points – Const. Volume gas Thermometer – Scales of Temperature, Ideal Gas Scale

### Module II

#### First Law of Thermodynamics

PMM I - Joule's Experiment – First law of Thermodynamics – extension of the First law to non - cyclic processes, energy, energy as a property, modes of energy, pure substance; Specific heat  $s$ , – Clausius – Clapeyron Equation, enthalpy, Corollaries – First law applied to a Process – Steady Flow Energy Equation. Limitations of the First Law – Thermal Energy Reservoir, Introduction to Heat Engine, Heat pump, Fuel Cell, Parameters of performance

#### Second Law of Thermodynamics

Second Law of Thermodynamics, Kelvin-Planck and Clausius Statements and their Equivalence, PMM of Second kind, Carnot's principle, Carnot cycle and its specialities, Thermodynamic scale of Temperature, Clausius Inequality, Entropy, Principle of Entropy Increase, Availability and Irreversibility, Causes of Irreversibility – Thermodynamic Potentials, Gibbs and Helmholtz Functions, Maxwell Relations – Elementary Treatment of the Third Law of Thermodynamics

**Module III****Pure Substances**

Pure Substances, p-V-T- surfaces, T-S and h-s diagrams, Phase Transformations –Triple point and critical state properties during change of phase, Sub-cooled liquid, saturated liquid, mixture of saturated liquid and vapour, saturated vapour and superheated vapour, states of pure substance with water as example. Dryness Fraction, Property tables. Mollier chart – Various Thermodynamic processes and energy Transfer –Steam Calorimetry.

**Perfect Gas laws**

Perfect Gas Laws – Equation of State, specific and Universal Gas constants – various Non-flow processes, properties, end states, Heat and Work Transfer, changes in Internal Energy – Throttling and Free Expansion Processes – Flow processes

**Module IV****Ideal Gas Mixtures**

Deviations from perfect Gas Model – Vander Waals Equation of State – Compressibility charts – variable specific Heats – Gas Tables Mixtures of perfect Gases – Mole Fraction, Mass fraction Gravimetric and volumetric Analysis – Dalton's Law of partial pressure, Avogadro's Laws of additive volumes – Mole fraction, Volume fraction, Equivalent Gas constant and Molecular Internal Energy, Enthalpy, sp. Heats and Entropy of Mixture of perfect Gases and Vapour.

**Psychrometry**

Atmospheric air - Psychrometric Properties – Dry bulb temperature, Wet Bulb Temperature, Dew point Temperature, Thermodynamic Wet Bulb Temperature, Specific Humidity, Relative Humidity, saturated Air, Vapour pressure, Degree of saturation – Adiabatic Saturation, Carrier's Equation – Psychrometric chart.

**Module V****Gas Power Cycles**

Otto, Diesel, Dual Combustion cycles – Description and representation on P-V and T-S diagram, Thermal Efficiency, Mean Effective Pressures on Air standard basis – comparison of Cycles. Brayton cycle, Bell-Coleman cycle.

**Vapour power Cycles**

Simple Rankine cycle – Performance Evaluation – combined cycle, Vapour compression refrigeration cycle-performance Evaluation.

**Text Books:**

1. Fundamentals of engineering thermodynamics by E.Rathakrishnan.
2. Thermodynamics', An Engineering Approach, YunusA. Cengel and Michael A.Boles, Tata McGraw Hill publications, 2002.
3. Engineering Thermodynamics / PK Nag / Mc Graw Hill

**Reference Books:**

1. Thermodynamics for Engineers / Kenneth A. Kroos ; Merle C. Potter/ Cengage.
2. Engineering Thermodynamics / Chattopadhyay/ Oxford, 2007.
3. Engineering Thermodynamics / Rogers / Pearson, 2010

**Online references:**

<https://nptel.ac.in/courses/112/105/112105123/>

**Course Outcomes:** At the end of the course the student should be able to

CO1 – Differentiate Between different thermodynamic systems and processes.

CO2 – Perform thermodynamic analysis by applying the laws of Thermodynamics to different types of systems undergoing various processes.

CO3 – Evaluate the properties using tables & charts on concepts of pure substances. Solve the problems using Psychrometric chart on concepts of gas mixtures, Psychrometric properties.

CO4 – Analyze the Thermodynamic cycles and evaluate Performance parameters.

<b>CO-PO/PSO Mapping Chart</b> (3/2/1 indicates strength of correlation) 3 – High; 2 – Medium; 1 - Low														
Course Outcomes (COs)	Program Outcomes (POs)												Program Specific Outcomes*	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
<b>CO1</b>	3	1	1	1								1	3	2
<b>CO2</b>	3	3	2	2								1	3	2
<b>CO3</b>	3	2	2	2								1	3	2
<b>CO4</b>	3	3	2	2								1	3	2

**B. Tech II Year–III Sem**

	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Subject Code:22PC3ME03</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**MATERIAL SCIENCE & METALLURGY**

**Pre-requisite:** Chemistry (Metallurgy and Atomic), Physics, Maths (Geometry)

**Course Objectives:**

1. This course is intended to provide basic knowledge on the metallurgical aspects of metals that are being used in our homes to various engineering applications.
2. It covers the fundamental aspects of materials, crystal structures and their representation, and various defects that are present in the materials
3. The necessity of alloying and the corresponding changes occurring in their phase diagrams are discussed.
4. A special focus is given on the important ferrous and non-ferrous alloys which are extensively used in the industries. Tailoring of material properties through different heat treatment processes with their microstructural changes are included.
5. The course concludes with discussion on materials other than metals that includes polymers, ceramics and advanced materials such as composites

**Module I****Crystal Structure**

Unit cells, Metallic crystal structures, Ceramics. Imperfection in solids: Point, line, interfacial and volume defects; dislocation strengthening mechanisms and slip systems, critically resolved shear stress.

**Crystal Structure Mechanisms**

Dislocation strengthening mechanisms and slip systems, critically resolved shear stress.

**Module II****Alloys and Phase Diagram**

Definition, necessity of alloying; Solid solutions: substitutional and interstitial, Hume-Rothery rules. Phase diagrams: Gibbs phase rule, unary phase diagram, cooling curves of pure metals, construction of phase diagram,

**Interpretation of Binary Diagrams** Tie line, Lever rule, various invariant reactions, Microstructure development upon cooling.

Iron Carbon phase diagram: Phases, Invariant reactions involved. Iron Iron-carbide phase diagram and microstructural aspects of ledeburite, austenite, ferrite and cementite, cast iron

**Module III****Heat Treatment Processes**

Annealing & their types, normalizing, spheroidizing, hardening and tempering, Surface hardening: flame and induction hardening, Case hardening: carburizing, nitriding, carburising and cyaniding,

**Transformation Diagrams**

Time-Temperature-Transformation (TTT) diagrams Fe-C alloys, bainite and martensite, continuous cooling curves and interpretation of final microstructures and properties. Special heat treatment processes: austempering & its limitations, martempering

**Module IV****Ferrous Alloys**

Introduction, Classification, Plain carbon steels: high, medium and low carbon steels, alloying of steels: stainless steels, tool steels and maraging steels; Cast irons: grey, white, malleable and spheroidal cast irons.

**Non Ferrous Alloys**

Copper alloys- brass, bronze and cupro-nickel; Aluminium and Aluminium alloys

**Module V****Polymers and Ceramics**

Introduction, classification, general characteristics, and potential applications.

**Introduction to composites materials**

Introduction to composites materials, classification of composite materials, fabrication methods of composites, general characteristics, and potential applications.

**Text Books:**

1. W. D. Callister, Materials Science and Engineering-An Introduction, Wiley India, 6th Edition, 2006.
2. V. Raghavan, Material Science and Engineering, Prentice Hall of India Private Limited, 1999.
3. Sidney H. Avener, Introduction to Physical Metallurgy, Tata McGraw hill education (P) Ltd, 2nd Edition, 2007.

**Reference Books:**

1. U. C. Jindal, Engineering Materials and Metallurgy, Pearson, 2011.
2. Kenneth G. Budinski and Michael K. Budinski, Engineering Materials, Prentice Hall of India Private Limited, 4th Indian Reprint, 2002.
3. V. D. Kodgire, Material Science and Metallurgy for Engineers, Everest, 1st Edition, 2006

**Online references:**

1. <https://nptel.ac.in/courses/113106032/>
2. <http://web.pdx.edu/~pmoeck/phy381/lecture1.pdf>

**Course Outcomes:** At the end of the course the student should be able to

CO1 – Explain basic concepts of crystal structures and their imperfections

CO2 – Interpret various phases present in the binary phase diagrams of alloys and comment on the micro structural development

CO3 – Recommend a heat treatment processes for the desired changes in properties

CO4 – Differentiate ferrous and non-ferrous alloys.

<b>CO-PO/PSO Mapping Chart</b> (3/2/1 indicates strength of correlation) 3 – High; 2 – Medium; 1 - Low														
<b>Course Outcomes (COs)</b>	<b>Program Outcomes (POs)</b>												<b>Program Specific Outcomes*</b>	
	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
<b>CO1</b>	3	2	2			2	2					2	2	1
<b>CO2</b>	3	2	2			2	2					2	2	1
<b>CO3</b>	3	2	2			2	2					2	2	1
<b>CO4</b>	3	2				2	2					2	2	1

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**B. Tech II Year–III Sem**

**L T P C**

**Subject Code:22PC3ME04**

**3 0 0 3**

## **PRODUCTION TECHNOLOGY**

**Pre-requisite:** Workshop Technology

### **Course Objectives:**

- 1 To teach the process-level dependence of manufacturing systems through tolerances.
- 2 To expose the students to a variety of manufacturing processes including their suitability and capabilities.
- 3 To teach the important effects that manufacturing processes may have on the material properties of the processed part with a focus on the most common processes.
- 4 To provide a technical understanding of common processes to aid in appropriate process selection for the material and required tolerances.

### **Module I**

#### **Casting and gating systems:**

Steps involved in making a casting – Advantage of casting and its applications; Patterns - Pattern making, Types, Materials used for patterns, pattern allowances; Properties of moulding sands. Methods of Melting - Crucible melting and cupola operation – Defects in castings; Principles of Gating – Requirements – Types of gates, Design of gating systems – Riser – Function, types of Riser and Riser design.

#### **Casting process:**

Casting processes – Types – Sand moulding, Centrifugal casting, die- casting, Investment casting, shell moulding; Solidification of casting – Solidification of pure metal, Directional Solidification.

### **Module II**

#### **Introduction to Welding:**

Classification – Types of welds and welded joints; Welding Positions.

#### **Welding processes:**

Gas welding - Types, Arc welding, forge welding, and submerged arc welding, Resistance welding, Thermit welding.

### **Module III**

#### **Advanced welding process:**

Inert Gas Welding \_ TIG Welding, MIG welding, Friction welding, Friction Stir Welding, induction welding, explosive welding, Laser Welding.

#### **Soldering, Brazing and Welding Defects:**

Soldering and Brazing; Heat affected zone in welding. Welding defects – causes and remedies; destructive and non- destructive testing of welds.

### **Module IV**

**Hot working and cold working Processes:**

Hot working, cold working, strain hardening, recovery, Sheet metal Operations: Stamping, Blanking and piercing, Coining, Strip layout, Hot and cold spinning – Bending and deep drawing.

**Rolling and Drawing:**

Rolling fundamentals – theory of rolling, types of Rolling mills and products. Drawing and its types – wire drawing and Tube drawing –. Types of presses and press tools.

**Module V****Extrusion of Metals:**

Basic extrusion process and its characteristics. Hot extrusion and cold extrusion - Forward extrusion and backward extrusion – Impact extrusion – Extruding equipment – Tube extrusion, Hydrostatic extrusion.

**Forging Processes:**

Forging operations and principles – Tools – Forging methods – Smith forging, Drop Forging – Roll forging – Forging hammers: Rotary forging – forging defects – cold forging, swaging, Forces in forging operations.

**Text Books:**

1. Manufacturing Technology / P.N. Rao Vol.1 & 2 / Mc Graw Hill.
2. Manufacturing Engineering & Technology / Serope Kalpakjian / Steven R. Schmid / Pearson.
3. A Text book of Production Technology (Manufacturing Processes) / Dr.P.C. Sharma / S. Chand Publications /1st Edition, 2006.

**Reference Books:**

1. Production Technology- R.K. Jain- Khanna
2. Production Technology / G. Thirupathi Reddy / Scitech
3. Manufacturing Processes- J.P. Kaushish- PHI

**Online references:**

<https://nptel.ac.in/courses/112/107/112107144/>

**Course Outcomes:** At the end of the course the student should be able to

- CO1 – Recognize the different types of casting process.
- CO2 – Identify types of production process .
- CO3 – Describe the various welding process.
- CO4 – Explain the concept of forging, rolling and drawing.



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**B. Tech II Year–III Sem**

**L T P C**

**Subject Code: 22PC3ME05**

**0 0 2 1**

**MATERIAL SCIENCE & MECHANICS OF SOLIDS LAB**

**Pre-requisite:** Engineering Physics, Applied maths.

**Course Objectives:**

1. To determine experimental data include universal testing machines and torsion equipment.
2. To determine experimental data for spring testing machine, compression testing machine, impact tester, hardness tester.
3. To determine stress analysis and design of beams subjected to bending and shearing loads using several methods
4. To determine Flexural strength of a beam.

**PART-A**

**List of Experiments (MOS)**

**Note:** Any eight experiments to be conducted

1. Tension test
2. Deflection test on Cantilever beam
3. Deflection test on simply supported beam
4. Torsion test
5. Spring test
6. Izod Impact test
7. Charpy impact test
8. Rockwell/Brinell hardness Test
9. Flexural strength of a beam

**PART-B**

**List of Experiments (MMS)**

**Note:** Any four experiments to be conducted

1. Preparation and study of crystal models for simple cubic, body centered cubic, face centered cubic and hexagonal close packed structures.
2. Preparation and study of the Microstructure of pure metals like Iron, Cu and Al.
3. Preparation and study of the Microstructure of Mild steels, low carbon steels, high – C steels.
4. Study of the Microstructures of Cast Irons.
5. Study of the Microstructures of Non-Ferrous alloys.
6. Hardenability of steels by Jominy End Quench Test.



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B. Tech II Year–III Sem

L T P C

Subject Code: 22PC3ME06

0 0 2 1

### PRODUCTION TECHNOLOGY LAB

**Pre-requisite:** Engineering workshop

#### Course Objectives:

1. Know about the basic Physical, Chemical Properties of materials
2. Explain why some material(s) are better to be used in a product for given design requirements
3. Learn the basic operation of various manufacturing processes
4. Learn how various products are made using traditional, non-traditional, or Electronics manufacturing processes
5. Design simple process plans for parts and products
6. Understand how process conditions are set for optimization of production
7. Learn how CNC machines work

**Note:** Any 10 experiments to be performed from all trades.

#### I. Metal Casting Lab:

1. Pattern Design and making - for one casting drawing.
2. Sand properties testing (for strengths, and permeability).
3. Moulding Melting and Casting.

#### II. Welding Lab:

1. ARC Welding Lap & Butt Joint
2. Spot Welding
3. TIG Welding
4. Plasma welding and Brazing (Water Plasma Device)

#### III. Mechanical Press Working:

1. Blanking & Piercing operation and study of simple, compound and progressive press tool.
2. Hydraulic Press: Deep drawing and extrusion operation.
3. Bending and other operations

#### IV. Processing of Plastics

1. Injection Moulding
2. Blow Moulding

**Text Books:** Dictionary of Mechanical Engineering – G.H.F. Nayler, Jaico Publishing House.

**Reference Books:** Dictionary of Mechanical Engineering – G.H.F. Nayler, Jaico Publishing House.

**Course Outcomes:** At the end of the course the student should be able to

CO1 – Understanding the properties of moulding sands and pattern making- Basic



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B.Tech II Year –III Sem

L T P C

Subject Code: 22ES3EE02

0 0 2 1

### **BASIC ELECTRICAL AND ELECTRONICS ENGINEERING Laboratory**

**Pre-requisite:** Basic Electrical and Electronics Engineering.

**Course Objectives:**

1. To introduce the concepts of electrical circuits and its components.
2. To get the practical experience with the operation and applications of electromechanical energy conversion devices.
3. To get the knowledge of the different electronic devices like diodes, rectifiers, transistors.
4. To learn how to measure the electrical quantities with different measuring devices and with CRO

#### **PART A: ELECTRICAL**

**Note: All experiments are mandatory**

1. Verification of ohms law
2. Verification of KVL and KCL
3. Verification of Superposition theorem.
4. Calculations and Verification of Impedance and Current of RL, RC and RLC series circuits.
5. Measurement of Voltage, Current and Real Power in primary and Secondary Circuits of a Single-Phase Transformer
6. Performance Characteristics of a Three-phase Induction Motor
7. Verification of Relationship between Voltages and Currents (Star-Delta, Delta-Delta, Delta star, Star-Star) in a Three-Phase Transformer

#### **PART B: ELECTRONICS**

**Note: Any three experiments should be conducted**

1. Study and operation of (i) multi-meters (ii) Function Generator (iii) Regulated Power Supplies (iv) CRO.
2. PN Junction diode characteristics
3. Zener diode characteristics and Zener as Voltage Regulator
4. Half Wave Rectifier Circuit
5. Full Wave Rectifier Circuit

**Text Books:**

1. Basic Electrical and Electronics Engineering –M S Sukija TK Nagasarkar Oxford University
2. Basic Electrical and electronics Engineering-D P Kothari. I J Nagarath, McGraw Hill Education

**Reference Books:**

1. Electronic Devices and Circuits – R. L. Boylestead and Louis Nashelsky, PEI/PHI, 9th Ed, 2006.
2. Millman’s Electronic Devices and Circuits – J. Millman and C. C. Halkias, Satyabrata Jit, TMH, 2/e, 1998
3. Network Theory by N. C. Jagan& C. Lakshminarayana, B.S. Publications



HR22

HITAM

B.Tech II Year–III Sem

L T P C

Subject Code: 22AC3HS01

0 2 0 0

### **Universal Human Values (UHV)**

(Common to ECE, EEE, ME, CSE, CSD, CSO, CSC, CSM branches)

#### **Course Objectives:**

1. To help students distinguish between values and skills, and understand the need, basic guidelines, content and process of value education.
2. To help students initiate a process of dialog within themselves to know what they 'really want to be' in their life and profession
3. To help students understand the meaning of happiness and prosperity for a human being.
4. To facilitate the students to understand harmony at all the levels of human living, and live accordingly.
5. To facilitate the students in applying the understanding of harmony in existence in their profession and lead an ethical life

#### **Module I**

##### **Self- Exploration on UHV Basic Guidelines**

Content and Process for Value Education Understanding the need, basic guidelines, Self-Exploration–what is it? - its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self-exploration.

##### **Continuous Happiness and Prosperity**

A look at basic Human Aspirations, Right understanding, Relationship and Physical Facilities- the basic requirements for fulfilment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity.

#### **Module II**

##### **Understanding Harmony in the Human Being**

Harmony in Myself Understanding human being as a co-existence of the sentient 'I' and the material 'Body', Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha, Understanding the Body as an instrument of 'I'

##### **Understanding Harmony in self**

Understanding the characteristics and activities of 'I' and harmony in 'I', Understanding the

harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail,

### **Module III**

#### **Understanding Harmony in the Family**

Harmony and Values in Relationships in the Family- the basic unit of human interaction, Trust (Vishwas) and Respect (Samman) as the foundational values of relationship, Understanding the meaning of Vishwas & Samman; Difference between intention and competence,

#### **Understanding Harmony in the Society**

Understanding the harmony in the society: Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive Human Goals, Visualizing Undivided Society (Akhand Samaj), Universal Order (SarvabhaumVyawastha).

### **Module IV**

#### **Understanding Harmony in the Nature and Existence**

Whole existence as Co-existence Understanding the harmony in the Nature, Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature

#### **Understanding Harmony in the Existence**

Understanding Existence as Co-existence (Sah-astitva) of mutually interacting units in all-pervasive space, Holistic perception of harmony at all levels of existence.

### **Module V**

#### **Exploring Attitudes towards gender**

Understanding gender and Basic Gender Concepts/terminology- exploring attitude towards gender-construction of gender- socialization: Making Women, making Men.

#### **Gender relationship and Culture**

Gender roles and relationship matrix, sex selection and consequences, declining sex ratio, Gender Issues- Gender sensitive language, Just Relationships: Being together as equals.

**Text Books:**

1. R R Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Human Values and Professional Ethics.
2. Towards a World of Equals: a bilingual Textbook on Gender. A Suneetha, and others... Telugu Academy, Telangana Gov. 2015

**References:**

1. Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and Harper Collins, USA
2. E.F. Schumacher, 1973, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs, Britain.
3. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991
4. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth – Club of Rome’s report, Universe Books.
5. A Nagraj, 1998, Jeevan Vidya Ek Parichay, Divya Path Sansthan, Amarkantak.

MOOC Course: NPTEL -Exploring Human Values: Visions of Happiness and Perfect Society - Web course

**Course Outcome:** On completion of this course, the students will be able to

CO1: Explore on the basic aspiration of Human being and its fulfilment

CO2: Distinguish the difference between the Self and the Body

CO3: Explore the value of harmony in family, society and nature

CO4: Understanding of gender related issues and gender relationship.

<b>O-PO Mapping Chart</b> (3/2/1 indicates strength of correlation) 3 – High; 2 – Medium; 1 – Low												
Course Outcomes (COs)	Program Outcomes (POs)											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1								3				
CO2								3				
CO3								3				
CO4								3				
CO5								3				

**B. Tech II Year–II Sem**  
**Subject Code: 22BS4MT06**

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3	1	0	4

## STATISTICAL METHODS AND COMPLEX VARIABLES

(Mechanical)

**Pre-requisite:** Basic knowledge of set and relations theory, permutations, combinations, Venn diagrams, measures of central tendency and dispersion. Complex numbers.

**Course Objectives:** To provide the student with

1. The ideas of probability and random variables.
2. Various discrete and continuous probability distributions and their properties.
3. Point estimation and interval estimation.
4. Testing of hypothesis and making statistical inferences.
5. Differentiation and integration of complex valued functions.
6. Evaluation of integrals using Cauchy's integral formula and Cauchy's residue theorem.
7. Expansion of complex functions using Taylor's and Laurent's series.

### MODULE I

**Probability:** Sample Space, Events, Counting Sample Points, and Probability of an Event, Addition theorem, Conditional Probability, Independent events, Multiplication theorem and Bayes' theorem.

**Random Variables:** Discrete and Continuous random variable. Definitions of Probability Distributions, Probability Mass function, Probability Density function. Definitions of Mathematical expectation, Variance and Moment generating function of Discrete and continuous random variables.

### MODULE II

**Discrete Probability Distributions:** Binomial Distribution, Poisson distribution and statistical constants of these distributions using moment generating function.

**Continuous Probability Distributions:** Uniform Distribution, Exponential Distribution, mean and variance of these distributions using moment generating function, Normal Distribution and its related applications.

### MODULE III

**Estimation and Tests of Significance:** Introduction, Statistical Inference, Classical Methods of Estimation.: Estimating the Mean, Standard Error of a Point Estimate, Null & Alternative Hypothesis, Critical region, Type I and Type II errors, level of significance, one tail, two-tail tests. Prediction Intervals: Estimating a Mean and Proportion for single sample, Difference between Two

Means, difference between two proportions for two Samples. Tests of significance for large sample: test for single mean, difference of means, single proportion, difference of proportions.

#### MODULE IV

**Complex Functions:** Limit, Continuity and Differentiation of Complex functions.

**Analytic Functions:** Analyticity, Cauchy-Riemann equations (without proof), Harmonic function and finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties.

#### MODULE V

**Complex Integrals:** Line integral, Cauchy's theorem, Cauchy's Integral formula, Zeros of analytic functions, Singularities.

**Poles and Residues:** Taylor's series, Laurent's series; Residues, Poles and Residues, Cauchy Residue theorem (without proof). Evaluation of Real definite integrals of the type  $\int_0^{2\pi} f(\sin\theta, \cos\theta)d\theta$ ,  $\int_{-\infty}^{\infty} f(x)dx$  (poles not on real axis). Conformal mapping and Mobius Transformations.

#### Text Books:

1. Introduction to Probability and Statistics for Engineers and Scientists, Sheldon M. Ross, 6<sup>th</sup> Edition, Elsevier, 2021
2. Complex Variables and Applications, J. W. Brown and R. V. Churchill, 7th Ed., Mc-Graw Hill, 2004.

#### Reference Books:

1. Introduction to Probability, Charles M Grinstead, J Laurie Snell, American Mathematical Society.
2. Probability and Statistics for Engineering and the Sciences, Jay Devore, Cengage learning.
3. Complex Analysis, Lars V Ahlfors, McGraw-Hill International Editions.
4. Complex Analysis, A R Vasishtha, Krishna Prakash Media(P) Ltd.,

#### MOOC Courses:

1. Probability: <http://nptel.ac.in/courses/111105041/>
2. Probability and Statistics: <http://nptel.ac.in/courses/111105035/>
3. Complex variables: <https://nptel.ac.in/courses/111/106/111106141/>

#### E- Books:

1. Probability and Statistics for Engineers by Richard A Johnson

<https://1lib.in/book/2883098/927b28>

2. Complex Variables and Applications by J. W. Brown and R. V. Churchill

<https://1lib.in/book/2574161/794c8d>

3. Introduction to Probability by Charles M Grinstead, J Laurie Snell

<https://1lib.in/book/556778/1a0fc2>

4. Probability and Statistics for Engineering and the Sciences by Jay Devore

<https://1lib.in/book/2820497/b2072c>

**Course Outcomes:** After learning the contents of this paper the student must be able to

CO1: Compute probabilities using theorems in probability.

CO2: Solve problems involving random variables and probability distributions.

CO3: Apply Inferential Statistics to make predictions or judgments about the population from which the sample data is drawn for large samples.

CO4: Analyze the complex function with reference to their analyticity, integration of complex functions by Cauchy’s integral and residue theorems also Taylor’s and Laurent’s series expansions in complex function.

<p align="center"><b>CO-PO/PSO Mapping Chart</b>                      (3/2/1 indicates strength of correlation)                      3 – High; 2 – Medium; 1 – Low</p>												
Course Outcomes (COs)	Program Outcomes (POs)											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2			1							
CO2	3	2			1							
CO3	3	1			1							
CO4	3	1			1							

HR22

HITAM

B. Tech II Year–IV Sem

L T P C

Subject Code: 22PC4ME07

3 0 0 3

### KINEMATICS OF MACHINES

**Pre-requisite:** Basic principles of Mechanics

**Course Objectives:**

1. To synthesis, both graphically and analytically, multilink mechanisms.
2. To perform mechanism analyses to find the position, velocity, acceleration, and dynamics of multi-bar mechanism.
3. To synthesis mechanism to perform certain prescribed task/motion
4. To analyze cam profiles.
5. To analyze gear trains.

#### Module I

##### Mechanisms

Elements or Links – Classification – Rigid Link, flexible and fluid link –Types of kinematics pairs – sliding, turning, rolling, screw and spherical pairs – lower and higher pairs – closed and open pairs – constrained motion – completely, partially or successfully and incompletely constrained.

##### Mechanism and Machines

Mobility of Mechanisms : Grubler’s criterion, classification of machines – kinematics chain – inversions of mechanism – inversions of quadric cycle chain, single and double slider crank chains, Mechanical Advantage.

#### Module II

##### Kinematics

Velocity and acceleration – Motion of link in machine – Determination of Velocity and acceleration – Graphical method – Application of relative velocity method.

##### Plane motion of body

Instantaneous center of rotation- centrodes and axodes – Three centers in line theorem – Graphical determination of instantaneous center, determination of angular velocity of points and links by instantaneous center method. Kliens construction - Coriolis acceleration - determination of Coriolis component of acceleration.

**Analysis of Mechanisms:** Analysis of slider crank chain for displacement- velocity and acceleration of slider – Acceleration diagram for a given mechanism.

**Module III****Straight-line motion mechanisms**

Exact and approximate copied and generated types – Peaucellier - Hart - Scott Russel – Grasshopper – Watt -Tchebicheff's and Robert Mechanism – Pantographs.

**Steering gear mechanisms:** Conditions for correct steering – Davis Steering gear, Ackerman's steering gear.**Hooke's Joint:** Single and double Hooke's joint –velocity ratio – application – problems.

**Module IV****Cams**

Definitions of cam and followers – their uses – Types of followers and cams – Terminology – Types of follower motion - Uniform velocity, Simple harmonic motion and uniform acceleration and retardation. Maximum velocity and maximum acceleration during outward and return strokes in the above 3 cases.

**Analysis of motion of followers**

Tangent cam with Roller follower – circular arc cam with straight, concave and convex flanks.

**Module V****Higher pair**

Friction wheels and toothed gears – types – law of gearing, condition for constant velocity ratio for transmission of motion – velocity of sliding Forms of teeth, cycloidal and involutes profiles – phenomena of interferences – Methods of interference. Condition for minimum number of teeth to avoid interference – expressions for arc of contact and path of contact of Pinion & Gear and Pinion & Rack Arrangements–Introduction to Helical – Bevel and worm gearing

**Gear Trains**

Introduction – Types – Simple – compound and reverted gear trains – Epicyclic gear train. Methods of finding train value or velocity ratio of Epicyclic gear trains.Selection of gear box - Differential gear for an automobile

**Text Books:**

1. Theory of Machines and Mechanisms(John J. Uicker, Gordon R.Pennock, Joseph E Shingley).
2. Theory of Machines by Rattan S S.
3. Theory of Machines by Thomas Bevan.

**Reference Books:**

1. Theory of Machines: Kinematics and Dynamics by Sadhu Singh.
2. Theory Of Mechanisms Machines by A Ghosh.
3. Mechanisms and Machine Theory by Rao J S and Dukkippatti R V.

**Online references:**

<https://youtu.be/MJeRFzs4oRU>

<https://youtu.be/vDEJxYGAoso>

**Course Outcomes:** At the end of the course the student should be able to

CO1 – Designing a suitable mechanism depending on application

CO2 – Analyze velocity and acceleration of different mechanisms using graphical methods

CO3 – Analyze displacement diagrams and cam profile diagram for followers executing different types of motions and various configurations of followers

CO4 – Analyze gear and gear train depending on application

<b>CO-PO/PSO Mapping Chart</b> (3/2/1 indicates strength of correlation) 3 – High; 2 – Medium; 1 - Low														
<b>Course Outcomes (COs)</b>	<b>Program Outcomes (POs)</b>												<b>Program Specific Outcomes*</b>	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
<b>CO1</b>	3	2	2										2	
<b>CO2</b>	3	2	2										2	
<b>CO3</b>	3	2	2										2	
<b>CO4</b>	3	2	2										2	

HR22

HITAM

B. Tech II Year–IV Sem

L T P C

Subject Code: 22PC4ME08

3 0 0 3

## IC ENGINES & GAS TURBINES

**Pre-requisites: Chemistry, Thermodynamics**

**Course Objectives:**

The students will learn

1. Apply the laws of Thermodynamics for I.C Engines, Compressors, Gas turbines
2. Analyse air standard cycles
3. Evaluate the performance analysis of the major components and systems of IC engines
4. Performance of Heat Engines in real-time applications by applying the various testing parameters of an engine (Brake power, Torque)
5. Techniques for improving the efficiencies and performance of compressors& gas turbines

### Module I

#### I.C Engines

Four and two stroke engine, SI and CI engines, valve and port timing diagrams, fuel properties and combustion, Stoichiometry

#### Assisted systems in IC Engines

Fuel injection systems for SI engines, fuel injection systems for CI engines, ignition systems, cooling and lubrication system

### Module II

#### Combustion in SI engines

Normal combustion and abnormal combustion, importance of flame speed and effect of engine variables, type of abnormal combustion, pre-ignition and knocking, fuel requirements and fuel rating, anti-knock additives, combustion chamber, requirements, types

#### Combustion in CI Engines

Four stages of combustion, delay period and its importance, effect of engine variables, diesel Knock, need for air movement, open and divided combustion chambers and nozzles used, fuel requirements and fuel rating

### Module III

#### Testing and performance

Parameters of performance, measurement of cylinder pressure, fuel consumption, air intake, exhaust gas composition, brake power, determination of frictional losses and indicated power, performance test, heat balance sheet and chart

**Compressors**

Classification, of compressors, fans, blower and compressor, positive displacement and dynamic types, reciprocating and rotary types

**Module IV****Rotary, dynamic and axial flow (positive displacement)**

Roots blower, vane sealed compressor, mechanical details and principle of working efficiency considerations; Centrifugal compressors: mechanical details and principle of operation, velocity and Pressure variation, Energy transfer, impeller blade shape-losses, slip factor, and power input factor, pressure coefficient and adiabatic coefficient, velocity diagrams, power.

**Axial flow compressors**

Mechanical details and principle of operation, velocity triangles and energy transfer per stage degree of reaction, work done factor, isentropic efficiency, pressure rise calculations, polytropic efficiency

**Module V**

Gas turbine and its classification, cycle analysis, introduction to Codes and Standards used in turbine design. Factors affecting design and performance of gas turbine combustion chamber, losses in turbines, estimation of turbine performance

**Alternative fuels**, their availability, properties, merits and demerits, requirements of fuels for IC engines, blends and other fuels used in CI engines, manufacturing, storage and performance analysis of alternative fuels, use of hydrogen, CNG, bio gas in SI engines, safety precautions, performance and emission characteristics

**Text Books:**

1. Ganesan, "I.C. Engines", Tata McGraw-Hill, 3rdEdition, 2011
2. R.K. Rajput, "Thermal Engineering", Lakshmi Publications, 1stEdition, 2011
3. B. John Heywood, "Internal Combustion Engine Fundamentals", Tata McGraw-Hill, 2ndEdition,2011.

**Reference Books:**

1. Mathur, Sharma, "IC Engines", DhanpatRai& Sons, 3rdEdition, 2008.
2. Pulkrabek, "Engineering Fundamentals of IC Engines", Pearson Education, 2ndEdition, 2008.
3. Rudramoorthy, "Thermal Engineering", Tata McGraw-Hill, 5thEdition 2003.

**Online references:**

1. <https://nptel.ac.in/courses/112102103/16>
2. <https://nptel.ac.in/courses/112107078/37>

**Course Outcomes:** At the end of the course the student should be able to

- CO1 – Understand the functionality of the major components of the IC Engines and effects of operating conditions on their performance.
- CO2 – Evaluate the performance parameters of I.C Engines, Compressors and Gas turbines.
- CO3 – Apply the laws of Thermodynamics to evaluate the performance of Gas turbine cycles.
- CO4 – Describe the need of various systems to run an Engine without failure.

<b>CO-PO/PSO Mapping Chart</b> (3/2/1 indicates strength of correlation) 3 – High; 2 – Medium; 1 – Low														
<b>Course Outcomes (COs)</b>	<b>Program Outcomes (POs)</b>												<b>Program Specific Outcomes*</b>	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
<b>CO1</b>	2	3				2	2						3	3
<b>CO2</b>	3	3	2										3	
<b>CO3</b>	3	3											3	
<b>CO4</b>	1	3	2										3	

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HITAM

B. Tech II Year–IV Sem

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Subject Code: 22PC4ME09

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**FLUID MECHANICS AND HYDRAULIC MACHINES**

**Pre-requisite: Basic Physics, Mathematics**

**Course Objectives:**

1. To understand the basic principles of fluid mechanics.
2. To identify various types of flows.
3. To understand boundary layer concepts and flow through pipes
4. To evaluate the performance of hydraulic turbines
5. To understand the functioning and characteristic curves of pumps.

**Module I**

**Fluid Statics**

Dimensions and units: physical properties of fluids- specific gravity, viscosity, and surface tension - vapour pressure and their influence on fluid motion- atmospheric.

**Pressure Measurement**

Gauge and vacuum pressures – measurement of pressure- Piezometer, U-tube and differential manometers.

**Module II**

**Fluid Kinematics**

Stream line, path line and streak lines and stream tube, classification of flows-steady & unsteady, uniform & non-uniform, laminar & turbulent, rotational & irrotational flows-equation of continuity for one dimensional flow and three-dimensional flows.

**Fluid Dynamics**

Surface and body forces –Euler’s and Bernoulli’s equations for flow along a streamline, momentum equation and its application on force on pipe bend.

**Module III**

**Boundary Layer Concepts**

Definition, thicknesses, characteristics along thin plate, laminar and turbulent boundary layers (No derivation) boundary layer in transition, separation of boundary layer, submerged objects – drag and lift.

**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. Measurement of flow: Pitot tube, venturi meter, and orifice meter, Flow nozzle

**Module 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, Heads and efficiencies, impulse and reaction turbines, Pelton wheel, Francis turbine and Kaplan turbine-working proportions, work done, efficiencies, hydraulic design –draft tube theory- functions and efficiency.

**Performance of hydraulic turbines:** Geometric similarity, Unit and specific quantities, characteristic curves, governing of turbines, selection of type of turbine, cavitation, surge tank, water hammer.

**Module V****Centrifugal Pumps**

Classification, working, work done – barometric head- losses and efficiencies specific speed-performance characteristic curves, NPSH.

**Reciprocating Pumps**

Introduction, construction details, working principle, types, Discharge, slip, indicator diagrams.

**Text Books:**

1. Hydraulics, Fluid mechanics and Hydraulic Machinery - MODI and SETH.
2. Fluid Mechanics : An Introduction, E Rathakrishnanan, PHI, 4 th Edition.
3. Fluid Mechanics and Fluid Power Engineering by D.S. Kumar, Kotaria & Sons

**Reference Books:**

1. Fluid Mechanics and Machinery by D. Rama Durgaiyah, New Age International.
2. Hydraulic Machines by Banga & Sharma, Khanna Publishers.

**Online Resources:**

1. <https://lecturenotes.in/subject/95/fluid-mechanics-and-hydraulic-machines-fmhm>
2. <https://www.smartzworld.com/notes/fluid-mechanics-hydraulic-machinery-notes-pdf-fmhm-notes-pdf>

**Course Outcomes:** At the end of the course the student should be able to

CO1-Identify various types of flows and formulate their governing equations.

CO2-Analyze the losses in pipe flows with the concepts of flow through pipes.

CO3- Evaluate hydrodynamic forces of jet striking different vanes from various angles.

CO4-Design the working proportions of hydraulic turbines and pumps.



HR22

HITAM

B.Tech II Year II Sem

L T P C

Subject Code: 22HS4HS01

2 0 0 2

### **BUSINESS ECONOMICS AND FINANCIAL ANALYSIS**

(Common to ECE, EEE, ME, CSE, CSD, CSO, CSC, CSM branches)

**Pre-requisite:** Nil

#### **Course Objectives:**

1. Describe concepts of business economics and demand analysis to help in optimal decision making in business environment
2. Differentiate the functional relationship between Production and factors of production and able to compute breakeven point to illustrate the various uses of breakeven analysis
3. Identify various market structures and discuss their implications for resource allocation
4. Explain various accounting concepts and different types of financial ratios for knowing financial positions of business concern.
5. Demonstrate an understanding of the concept of capital budgeting and allocations of the resources through capital budgeting methods and compute simple problems for project management.

#### **Course Outcomes:**

1. Understand economics and business economic concepts
2. Differentiate different business organisations and nurture the idea of start-ups
3. Analyze operations of markets under varying competitive conditions
4. Apply accounting concepts and methods to interpret financial statements for evaluating the financial position and performance of organizations

#### **Module I INTRODUCTION TO BUSINESS AND ECONOMICS**

**Business:** Structure of Business Firm, Theory of Firm, Types of Business Entities, Limited Liability Companies, Sources of Capital for a Company

**Economics:** Significance of Economics, Micro and Macro Economic Concepts, Concepts and Importance of National Income, Inflation, Business Cycle, Features and Phases of Business Cycle. Nature and Scope of Business Economics, Role of Business Economist, Multidisciplinary nature of Business Economics.

#### **Module II DEMAND AND SUPPLY ANALYSIS**

**Elasticity of Demand:** Demand, Law of Demand, Elasticity, Types of Elasticity, Measurement and Significance of Elasticity of Demand, Factors affecting Elasticity of Demand,

**Demand Forecasting:** Steps in Demand Forecasting, Methods of Demand Forecasting.

**Supply Analysis:** Determinants of Supply, Supply Function & Law of Supply

#### **Module III PRODUCTION, COST, MARKET STRUCTURES & PRICING**

**Production Analysis:** Factors of Production, Production Function, Production Function with one variable input, two variable inputs, Returns to Scale, Different Types of Production Functions. Cost analysis: Types of Costs, Short run and Long run Cost Functions.



HR22

HITAM

**B. Tech II Year-IV Sem**

**L T P C**

**Subject Code: 22PC4ME10**

**0 0 2 1**

### **COMPUTER AIDED MACHINE DRAWING PRACTICE**

**Pre-requisite:** Engineering graphics

#### **Course Objectives:**

1. To familiarize with the standard conventions for different materials and machine parts in working drawings.
2. To make part drawings including sectional views for various machine elements. To prepare assembly drawings given the details of part drawings.
3. The student will acquire knowledge of fastening arrangements such as welding, riveting the different styles of attachment for shaft.
4. The student also is enabled to prepare the assembly of various machine or engine components and miscellaneous machine components.

#### **Computer Aided & Manual Drawing of Machine Elements and simple parts.**

1. Popular forms of Screw threads, bolts, nuts, stud bolts, tap bolts, set screws.
2. Keys, cottered joints and knuckle joint.
3. Rivetted joints for plates
4. Shaft coupling, spigot and socket pipe joint.
5. Journal, pivot and collar and foot step bearings.

#### **Assembly Drawings:**

Drawings of assembled views for the part drawings of the following using conventions and easy drawing proportions. (Any two from each topic).

1. Steam engine parts – stuffing boxes, cross heads, Eccentrics.
2. Machine tool parts: Tail stock, Tool Post, Machine Vices.
3. Other machine parts - Screws jacks, Petrol engine connecting rod, Plummer block, Fuel Injector
4. Valves - Steam stop valve, spring loaded safety valve, feed check valve and air cock.

**Text Books:** Machine Drawing –K.L. Narayana, P.Kannaiah & K. Venkata Reddy / New Age/ Publishers.



**B. Tech II Year–IV Sem****L T P C****Subject Code: 22PC4ME11****0 0 2 1****FLUID MECHANICS AND HYDRAULIC MACHINES LAB****Course Objectives:**

At the end of course students are able to

1. Develop procedure for standardization of experiments.
2. Calibrate flow discharge measuring devices used in pipes.
3. Determine the major and minor losses in a given pipe.
4. Prove that the total head at any point along the fluid flow is same.
5. Test the performance of pumps and turbines

**LIST OF EXPERIMENTS:**

**Note:** Any Ten experiments to be conducted.

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 Orifice meter.
10. Determination of friction factor for a given pipe line.
11. Determination of loss of head due to sudden contraction in a pipeline.
12. Verification of Bernoulli's Theorems.

**Course Outcomes:** At the end of the course the student should be able to

CO1-Describe the calibration of measuring devices

CO2-Identify various types of flows and their function

CO3-Analyze the losses in pipe flows with the concepts of flow through pipes.

CO4-Test the performance of hydraulic turbines and pumps.



B.Tech II Year–I Sem/II Sem

L T P C

Subject Code:22HS4EG03

0 0 2 1

**English for Employability Lab****(Common to ECE, EEE, ME, CSE, CSD, CSO, CSC, CSM branches)****Course Objectives:**

1. To improve the communication skills, body language, facial expression and gesture.
2. To be able to understand the concept of employability skills (Quantum dexterity) and enhancing ones' behavior in the personal, professional and social forum.
3. To evaluate the LSRW (listening, speaking, reading and writing) through assessment.
4. To learn the basic grammar for improving spoken and written communication.
5. To become problem solver, analyze and apply critical and analytical skills.
6. To Identify the Employability skills, assigning tasks (Group Discussion, JAM, Role play etc.,) for day today evaluation.

## Activity

**1- Narration (Historical places, events, Picture narration, Memorable incidents of life)**

Self Intro, Daily Routine, Likes & Dislikes, Vocabulary, Triangular Activity (Person based- S-P), Imperatives & JAM

**Targeted Skills-** Listening- Speaking- Audio-Video clips

Activity 2: **Quantum of Dexterity (QOD)**-- Ability (Personal, Behavioural & Professional) Request/Permission/Order, Survival kit, Career Objective Professional, Hidden Talents (Personal), Character Traits (Behavioural)

**Targeted Skills-** Reading-Writing – Concluding an open-ended Story, Creative Writing.

**Activity 3: Critical & Analytical Skills**

SWOC- (Social & Cultural, Political, Economic, Legal Impact, Technical, Nuances of

Pronunciation, Voice Modulation, Neutralizing Mother Tongue Interference, Tongue Twisters for practice,

**Targeted Skills-** Writing SWOC, Self-Introduction, Exposure to a structured talk.

**Activity 4: Flick Flow/Extempore**

Mind Mapping, Wh- questions, Steps of Presentation, Use of Visual Aids, Individual/Group Presentation for practice.

**Targeted Skills-** Speaking Skills

**Activity 5: On Job Training**

Formal & Informal communication, Resume E-mail Etiquette, Telephonic & Interview Etiquette, Situation based- Santa's Bag, topic/case study-based Group Discussion, Kicks me! (Job Consultancy/Role Play)

**Targeted Skills-** Listening-Writing- Speaking

**Course Outcomes:** After undergoing this course, the student will be able to;

**CO1: Understand** the explicit and implicit of importance of employability skills.

**CO2: Demonstrate** life skills like team work, learning skills, problem solving, attitude, adaptability and flexibility.

**CO3: Apply** critical and analytical skills to bring out the solution on problem/case study.

**CO4: Recognize** the need of appropriate words, Phrases & functional grammar and apply them in both spoken and written communication.

<b>CO-PO Mapping Chart</b> (3/2/1 indicates strength of correlation) 3 – High; 2 – Medium; 1 – Low												
<b>Course Outcome s (COs)</b>	<b>Program Outcomes (POs)</b>											
	<b>P O 1</b>	<b>P O 2</b>	<b>P O 3</b>	<b>P O 4</b>	<b>P O 5</b>	<b>P O 6</b>	<b>P O 7</b>	<b>P O 8</b>	<b>P O 9</b>	<b>P O 10</b>	<b>P O 11</b>	<b>P O 12</b>
<b>CO1</b>									2			
<b>CO2</b>									2	2		
<b>CO3</b>		3								3		
<b>CO4</b>										3		3

<b>B.Tech II Year–IV Sem</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Subject Code: 22PR4ME02</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>

### **DOING ENGINEERING -1**

**Description:** 3D Modeling & Drafting of a Machine/Equipment/Assembly - Lathe/Two Wheeler/Electrical Transformer/Injection Moulding Machine

**Prerequisite:** Engineering Drawing

**Course Objectives:**

1. To familiarize the assembly and Disassembly of industrial / automotive equipment
2. To familiarize the practicing engineering through a doing engineering methodology with a equipment.
3. To make 3D models of various machine elements.
4. To make part drawings including sectional views for various machine elements.
5. To prepare assembly drawings given the details of part drawings.

**Assembling and Disassembling of an equipment by hands-on experience**

1. Disassembly of equipment (Lathe/ Two Wheeler/ Electrical Transformer/ Injection Moulding Machine).
2. Design thinking of selected assembly. (Measurement of each component, Hand Sketch of the components with dimensions. Hand sketch of the Assembly and its mechanism)
3. Solid modeling for components level
4. Presentation on components (solid modeling)
5. Presentation on manufacturing.
6. Physical Assembling of equipment.
7. Make a video & report preparation along with any other two assembly teams.

**Text Books:**

1. Training Manuals of SOLID WORKS/AUTOCAD/FUSION 360.

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

1. Demonstrate competency with multiple drawing and modifications.
2. Create three-dimensional solid models.
3. Create three-dimensional assemblies incorporating multiple solid models.
4. Apply industry standards in the preparation of technical drawings.

**Assessment: Three hours exam:**

1. 40 marks: Continuous Internal Evaluation
2. 60 Marks: External Evaluation.

<b>CO-PO/PSO Mapping Chart</b> (3/2/1 indicates strength of correlation) 3 – High; 2 – Medium; 1 - Low														
<b>Course Outcomes (COs)</b>	<b>Program Outcomes (POs)</b>												<b>Program Specific Outcomes*</b>	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
<b>CO1</b>	3	2			3				3	3				
<b>CO2</b>	3	2			3				3	3			2	2
<b>CO3</b>	3	2			3				3	3			2	2
<b>CO4</b>	3	2			3				3	3				

<b>B.Tech II Year IV Sem</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Subject Code: 21MC4HS07</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>0</b>

### **Constitution of India (CoI)**

**(Common to ECE, EEE, ME, CSE, CSD, CSO, CSC, CSM branches)**

The Constitution of India is the supreme law of India. Parliament of India cannot make any law which violates the Fundamental Rights enumerated under the Part III of the Constitution. The Parliament of India has been empowered to amend the Constitution under Article 368; however, it cannot use this power to change the “basic structure” of the constitution, which has been ruled and explained by the Supreme Court of India in its historical judgments. The Constitution of India reflects the idea of “Constitutionalism” – a modern and progressive concept historically developed by the thinkers of “liberalism” – an ideology which has been recognized as one of the most popular political ideology and result of historical struggles against arbitrary use of sovereign power by state. The historic revolutions in France, England, America and particularly European Renaissance and Reformation movement have resulted into progressive legal reforms in the form of “constitutionalism” in many countries. The Constitution of India was made by borrowing models and principles from many countries including United Kingdom and America.

The Constitution of India is not only a legal document but it also reflects social, political and economic perspectives of the Indian Society. It reflects India’s legacy of “diversity”. It has been said that Indian constitution reflects ideals of its freedom movement; however, few critics have argued that it does not truly incorporate our own ancient legal heritage and cultural values. No law can be “static” and therefore the Constitution of India has also been amended more than one hundred times. These amendments reflect political, social and economic developments since the year 1950. The Indian judiciary and particularly the Supreme Court of India has played an historic role as the guardian of people. It has been protecting not only basic ideals of the Constitution but also strengthened the same through progressive interpretations of the text of the Constitution. The judicial activism of the Supreme Court of India and its historic contributions has been recognized throughout the world and it gradually made it “as one of the strongest court in the world”.

### **Course content**

1. Meaning of the constitution law and constitutionalism
2. Historical perspective of the Constitution of India
3. Salient features and characteristics of the Constitution of India
4. Scheme of the fundamental rights
5. The scheme of the Fundamental Duties and its legal status
6. The Directive Principles of State Policy – Its importance and implementation
7. Federal structure and distribution of legislative and financial powers between the Union and the States
8. Parliamentary Form of Government in India – The constitution powers and status of the President of India
9. Amendment of the Constitutional Powers and Procedure
10. The historical perspectives of the constitutional amendments in India
11. Emergency Provisions: National Emergency, President Rule, Financial Emergency
12. Local Self Government – Constitutional Scheme in India
13. Scheme of the Fundamental Right to Equality
14. Scheme of the Fundamental Right to certain Freedom under Article 19
15. Scope of the Right to Life and Personal Liberty under Article 21