HYDERABAD INSTITUTE OF TECHNOLOGY AND MANAGEMENT
B.TECH. HR-21 COURSE STRUCTURE
MECHANICAL ENGINEERING

(Applicable for the batch admitted from 2021-22 onwards)

III – Semester (II – Year)

S. No.	Course code	Subject	Hours Per Week			Credits	Scheme of Evaluation		
			L	T	P		Maximum Marks		
							Int.	Ext.	Tot.
1	21ES3EE01	Basic Electrical & Electronics Engineering	3	0	0	3	30	70	100
2	21PC3ME01	Mechanics of Solids	3	0	0	3	30	70	100
3	21PC3ME02	Thermodynamics	3	0	0	3	30	70	100
4	21PC3ME03	Material Science & Metallurgy	3	0	0	3	30	70	100
5	21PC3ME04	Production Technology	3	0	0	3	30	70	100
6	21HS3EG03	English for Employability	1	0	0	1	30	70	100
7	21HS3EG04	English for Employability-Lab	0	0	2	1	30	70	100
8	21PC3ME05	Material Science & Mechanics of Solids Lab	0	0	3	1.5	30	70	100
9	21PC3ME06	Production Technology Lab	0	0	2	1	30	70	100
10	21ES3EE02	Basic Electrical & Electronics Engineering Lab	0	0	3	1.5	30	70	100
11	21PR3IN01	Internship -1	0	0	3	1	100	0	100
TOTAL						**22**	**400**	**700**	**1100**
Non Credit Courses									
12	21MC3HS01	Universal Human Values	2	0	0	0	100	0	**100**

IV – Semester (II – Year)

S. No.	Course code	Subject	Hours Per Week			Credits	Scheme of Evaluation		
			L	T	P		Maximum Marks		
							Int.	Ext.	Tot.
1	21ES4MT07	Statistical Methods and Complex Variables	3	1	0	4	30	70	100
2	21PC4ME07	Kinematics of Machinery	3	1	0	4	30	70	100
3	21PC4ME08	Thermal Engineering-I	3	0	0	3	30	70	100
4	21ES4CS03	Python Programming	3	0	0	3	30	70	100
5	21PC4ME09	Fluid Mechanics & Hydraulic Machinery	3	0	0	3	30	70	100
6	21PC4ME10	Machine Drawing Practice	0	0	2	1	30	70	100
7	21PC4ME11	Fluid Mechanics & Hydraulic Machinery Lab	0	0	2	1	30	70	100
8	21ES4CS04	Python Programming Lab	0	0	3	1.5	30	70	100
9	21PR4ME01	**Doing Engineering-1**	0	0	3	1.5	30	70	100
TOTAL						**22**	**270**	**630**	**900**

B.Tech II Year–III Sem	L	T	P	C
Subject Code: 21PC3ME01	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

Unit 1: 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.

Unit 2: 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

Unit 1: 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.

Unit-2: 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

Unit 1: 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.

Unit 2: Columns-Struts and Columns, Stability of columns, Euler's formula for different end conditions, Equivalent load, Eccentric loading, Rankine's formula.

Module IV

Unit 1: Torsion Deformation in circular shaft due to torsion, basic assumptions, torsion equations, stresses in elastic range, angular deflection, hollow & stepped circular shaft.

Unit 2: Strain Energy Introduction, Strain energy, Proof Resilience, Elastic strain energy in tension, compression, bending and torsion. Impact loading in tension and bending.

Module V
Unit 1: Combined Loading on shafts and **failure theories:** Components subjected to bending, torsion & axial loads. Theories of failure.

Unit 2: Thin Cylinders: Thin seamless cylindrical shells – longitudinal and circumferential stresses. Thin spherical shells.

Text Books:
1. Strength of Materials – by R.K. Rajput, 6th Edition S Chand Publication, January 2015
2. Strength of Materials- by Khurmi & Gupta, Revised Edition S Chand Publication, 2006

Reference Books:

1. Strength of Material – Dr. Sadhu Singh – 7th Edition Khanna Publishers 2017
2. Mechanics of Material-Gere and Timoshenko 2nd Edition CBS Publications 2004
3. Mechanics of Material – F.P. Bear & E.E. Johnston – 8th Edition McGraw Hill, 2020
4. Engineering Mechanics of Solids –E.P. Popov –2nd 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:

- 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

CO-PO/PSO Mapping Chart (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**
CO1	3	3	2										2	
CO2	3	3	2										2	
CO3	3	3	2										2	
CO4	3	3	2										2	

B.Tech II Year–III Sem	**L**	**T**	**P**	**C**
Subject Code: 21PC3ME02	**3**	**0**	**0**	**3**

Thermodynamics

Pre-requisite: Engineering Chemistry 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, Refrigeration Tables (Permitted to use in examinations)]

Module I
Unit 1: 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,

Unit 2: 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
Unit 1: 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 heats, – 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

Unit 2: 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

Unit 1: 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.

Unit 2: 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

Unit 1: Ideal Gas Mixtures

Deviations from perfect Gas Model – Vader Waals Equation of State – Compressibility charts – variable specific Heats – Gas Tables Mixtures of perfect Gases – Mole Fraction, Mass friction 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.

Unit 2: 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

Unit 1: 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.

Unit 2: Vapour power Cycles

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

Text Books:

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

Reference Books:

1. Thermodynamics for Engineers / Kenneth A. Kroos ; Merle C. Potter/ Cengage.
2. An Introduction to Thermodynamics', Y.V.C.Rao, Wiley Eastern, 1993,

3. Engineering Thermodynamics / Chattopadhyay/ Oxford, 2007.
4. Engineering Thermodynamics / Rogers / Pearson, 2010

Online references :

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

Course Outcomes:

- 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.

CO-PO/PSO Mapping Chart

(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**
CO1	H	L		L									L	
CO2	H	H		M									L	
CO3	H	M		M									L	
CO4	H	H		M									L	

B.Tech II Year–III Sem

Subject Code: 21PC3ME03

L	T	P	C
3	0	0	3

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

Unit 1: 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.

Unit 2: Crystal Structure Mechanisms

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

Module II

Unit 1: 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,

Unit 2: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 microstrctural aspects of ledeburite, austenite, ferrite and cementite, cast iron

Module III

Unit 1:Heat Treatment Processes

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

Unit 2: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

Unit 1: 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.

Unit 2:Non Ferrous Alloys

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

Module V

Unit 1: Polymers and Ceramics

Introduction, classification, general characteristics, and potential applications.

Unit 2: 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:

- 1.CO1 – Explain basic concepts of crystal structures and their imperfections

- 2.CO2 – Interpret various phases present in the binary phase diagrams of alloys and comment on the microstructural development
- 3.CO3 – Recommend a heat treatment processes for the desired changes in properties
- 4.CO4 – Differentiate ferrous and non-ferrous alloys.

CO-PO/PSO Mapping Chart **(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**
CO1	3	2	2			2	2					2	2	
CO2	3	2	2			2	2					2	2	
CO3	3	2	2			2	2					2	2	
CO4	3	2				2	2					2	2	

B.Tech II Year–III Sem	L	T	P	C
Subject Code: 21PC3ME04	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

Unit 1: 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..

Unit 2: 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

Unit 1: Introduction to Welding:

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

Unit 2: Welding processes:

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

Module III

Unit 1: Advanced welding process:

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

Unit 2: 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
Unit 1: 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.

Unit 2: 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
Unit 1: 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.

Unit 2: 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

Reference Books:
Production Technology- R.K. Jain- Khanna
Production Technology / G. Thirupathi Reddy / Scitech
Manufacturing Processes- J.P. Kaushish- PHI

Online references:

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

Course Outcomes:
- 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.

CO-PO/PSO Mapping Chart (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**
CO1	3												2	
CO2	3	3			2								2	
CO3	3					2							2	
CO4	2					1							2	

B.Tech II Year–III Sem

Subject Code: 21PC3ME05

L	T	P	C
0	0	3	1.5

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/Brinel 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.

Text Books;
Strength of Materials by R.K. Rajput

Online references:
https://sm-nitk.vlabs.ac.in/#

Course Outcomes:

- CO1 – Analyze the behavior of the solid bodies subjected to various types of loading.
- CO2 – Apply knowledge of materials and structural elements to the analysis of simple structures.
- CO3 – Undertake problem identification, formulation and solution using a range of analytical methods
- CO4 – Analyze and interpret laboratory data relating to behavior of structures and the materials they are made of, and undertake associated laboratory work individually and in teams.

CO-PO/PSO Mapping Chart (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**
CO1	H	M											H	
CO2	H	M												
CO3	H												H	
CO4	H	M												

B.Tech II Year–III Sem

Subject Code: 21PC3ME06

L	T	P	C
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 12 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:

- CO1 – Understanding the properties of moulding sands and pattern making- Basic
- CO2 – Fabricate joints use gas welding and arc welding and evaluate the quality of welded joints.
- CO3 – Idea of press working tools and types of dies
- CO4- Performs moulding studies on plastics.

CO-PO/PSO Mapping Chart **(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**
CO1	3												1	
CO2	3	2												1
CO3	3					2							1	
CO4	3													

B.Tech II Year–III Sem	L	T	P	C
Subject Code: 21ES3EE01	3	0	0	3

Basic Electrical & Electronics Engineering

(Common to CSE/EEE/ECE/CSM/CSD/CSC/CSO)

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 facto and its improvement.
5) To introduce the concepts of diodes & transistors.

Module I: D.C. Circuits

UNIT 1: Introduction to Electrical Circuits

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

Unit 2: Network Theorems

Superposition, Thevenin's, Norton's theorems with simple problems.

Module II: A.C. Circuits

UNIT 1: Single Phase AC Circuits

Representation of sinusoidal waveforms, Average and RMS values, peak factor and Form factor. Real power, Reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel). Resonance in series RLC circuits.

UNIT 2: Three Phase AC Circuits

Three-phase balanced circuits, voltage and current relations in star and delta connections.

Module III: Electrical Machines

UNIT 1: DC Machines: Construction and working principle of DC generators, EMF equation, and working principle of DC motors, Torque equations, Speed control of DC motors.

UNIT 2: AC Machines: 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

UNIT 1: P-N JUNCTION AND ZENER DIODE: Principle of Operation of Diode, Volt-Ampere characteristics, Zener diode characteristics, applications.

UNIT 2: RECTIFIERS: P-N junction as a rectifier - Half Wave Rectifier, Ripple Factor - Full Wave Rectifier, Bridge Rectifier.

Module V: BIPOLAR JUNCTION TRANSISTORS

UNIT 1: BIPOLAR JUNCTION TRANSISTOR (BJT): Construction, Principle of Operation, Current amplification factor, Transistor as amplifier.

UNIT 2: FIELD EFFECT TRANSISTOR (FET): MOSFET, Input – output characteristics, Applications.

TEXT BOOKS:

1. A Chakrabarthy, "Electric Circuits", Dhanipat Rai & Sons, 6th Edition, 2010. L.S. Bobrow, Fundamentals of Electrical Engineering", Oxford University Press, 2011

2. Basic Electrical and electronics Engineering-D P Kothari. 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**
2. **https://www.opentextbooks.org.hk/system/files/export/9/9648/pdf/Fundamentals_of_Electrical_Engineering_I_9648.pdf**

Course Outcomes:

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

CO1 – To analyse the electrical circuits with DC excitation.

CO2 – To analyse electrical circuits with AC excitation

CO3 – To Explain the working principles of electrical machines

CO4 – To Analyse the characteristics of Electronic devices like diodes and transistors

CO-PO/PSO Mapping Chart (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	2	2			1							
CO2	2	3										
CO3	2	1										
CO4	2	2										

B.Tech II Year–III Sem	L	T	P	C
Subject Code: 21HS3EG03	1	0	0	1

English For Employability

(Common to CSE/EEE/ECE/CSM/CSD/CSC/CSO/MECH)

Course Objective:

1. To introduce growing need of English Language Skills for Employability (ELSE).
2. To help the students understand the importance of inter-personal communication, team dynamics and role behaviour at the work place
3. To enhance their Behavioural skill and Entrepreneurship skills.

Module I- **Wings of Fire**
Unit 1: "Orientation" an excerpt from ***Wings of fire***-An Autobiography of Abdul Kalam by Arun Tiwari.
Unit 2: **Grammar**
Vocabulary- Omission of Articles, Collective Nouns, Prepositions, Collocations.
Reading- Observation Passage, Survey Passage
Writing- Comprehension Passages based on graphs, charts & other illustrations.

Module II **5 Points Someone**
Unit 1: The Gift an excerpt from ***5 Points Someone*** by Chetan Bhagat
Unit 2: Grammar -
Vocabulary- Advanced Collocations, Proverbs, Idioms, One word Substitute
Reading – Complex passage, Reading Comparison,
Writing- Usage of Idioms and Proverbs in Passage

Module III – **Wise Leaders Wanted & Shift Your Perspective: Connect to Your Noble Purpose**
Unit 1: "Wise Leaders Wanted & Shift Your Perspective: Connect to Your Noble Purpose" an excerpt from ***From Smart to Wise: Acting and Leading with Wisdom*** Kaipa, Prasad, and Navi Radjou.
Unit 2: Grammar
Vocabulary- Technical vocabulary, Auxiliaries and Modals,
Reading- Technical Comprehension,
Writing- Creative Resume.

Module IV- **Variation Under Nature**
Unit 1: "Variation Under Nature" an excerpt from ***Origin of Species*** by Charles Darwin
Unit 2: Grammar
Vocabulary- Coherence-Cohesive devices, Figures of speech
Writing- Story writing, Picture composition, Review of movie/match/book.
Reading- Inferring Reading, Survey, Question, Read, Recite and Review (SQ3R)

Module V- **Let's Build a Company: A Start-up Story Minus the Bullshit**
Unit 1: *Let's Build a Company: A Start-up Story Minus the Bullshit by Harpreet Grover and Vibhore Goyal*

Unit 2: **Grammar**
Vocabulary- Topic/Situation based Vocabulary, Tongue Twisters.
Reading- Critical Reading of known/unknown passages
Writing- Common Errors in Tenses, Description of hobbies, Future plans,
Reported Speech: Direct & Indirect Speech, Email Writing, Formal letter writing (Enquiry, Apology, Leave, Request) Notice Writing, Information Transfer, Technical report writing

Textbooks

1. Azad, Abdul Kalam, Wings of Fire. Generic pub. 2009.
2. Kaipa, Prasad, and Navi Radjou. *From Smart to Wise: Acting and Leading with Wisdom*. Jossey-Bass, 2013.
3. Grover, Harpreet S., and Vibhore Goyal. *Let's Build a Company: A Start-up Story Minus the Bullshit*. Penguin Books, 2020.
4. Wren & Martin High School English Grammar & Composition. New Delhi: S. Chand. 1999.

References

1. Adair, John. Effective Communication. London: Pan Macmillan Ltd., 2003.
2. Writing Skills Practice Book for EFL - English Teaching Forum Writing Skills Practice Book for EFL. Beginning/Intermediate Level.
3. Patricia Wilcox Peterson. Ajmani, J. C. Good English: Getting it Right. New Delhi: Rupa Publications, 2012.
4. Amos, Julie-Ann. Handling Tough Job Interviews. Mumbai: Jaico Publishing, 2004.
5. Murphy, R. *Intermediate English Grammar*.
6. English Grammar & Composition by S.C. Gupta. New Delhi: Cambridge, 2006.

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

CO1: Understand the concept and process of employability skills.
CO2: Demonstrate the employability skills in both verbal and non-verbal communications.
CO3: Apply skill identification strategies to bring out the results on social and industry demands.
CO4: Recognize right professional, Entrepreneurship skills and social ethical values.

CO-PO Mapping Chart (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									**2**			
CO2									**2**	**2**		
CO3								**3**		**3**		
CO4										**3**		**3**

B.Tech II Year–III Sem	L	T	P	C
Subject Code: 21HS3EG04	0	0	2	1

English For Employability Lab

(Common to CSE/EEE/ECE/CSM/CSD/CSC/CSO/MECH)

Prerequisites:

1. Basic knowledge of interpersonal and communication skills.
2. Enriching the speaking and writing ability
3. Basic grammar rules of (LSRW)
4. Basic Spoken English skills

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-Introduction, 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 (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.

CO-PO Mapping Chart (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									**2**			
CO2									**2**	**2**		
CO3		**3**								**3**		
CO4										**3**		**3**

B.Tech II Year–III Sem	L	T	P	C
Subject Code: 21MC3HS01	2	0	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

UNIT 1: 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.

UNIT 2: 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

UNIT 1: 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'

UNIT 2: 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

UNIT 1: 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,

UNIT 2: 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

UNIT 1: 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

UNIT 2: 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

UNIT 1: Exploring Attitudes towards gender

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

UNIT 2: 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.

O-PO Mapping Chart (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–IV Sem

Subject Code: 21PC4ME07

L	T	P	C
3	1	0	4

KINEMATICS OF MACHINERY

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

Unit 1: 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.

Unit 2: 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

Unit 1: Kinematics

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

Unit 2: 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

Unit 1:Straight-line motion mechanisms

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

Unit 2: 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

Unit 1: 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.

Unit 2: Analysis of motion of followers

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

Module V

Unit 1: 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

Unit 2: 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 / S.S. Rattan / Mc Graw Hill Publishers.
2. Theory of Machines and Mechanisms/JOSEPH E. SHIGLEY/ Oxford.

Reference Books:

1. Theory of Machines / Sadhu Singh / Pearson.
2. Theory of Machines / Thomas Bevan /CBS

Online references:

https://youtu.be/MJeRFzs4oRU
https://youtu.be/yDEJxYGAoso

Course Outcomes:

- 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

CO-PO/PSO Mapping Chart **(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**
CO1	3	2	2										2	
CO2	3	2	2										2	
CO3	3	2	2										2	
CO4	3	2	2										2	

B.Tech II Year–IV Sem

Subject Code: 21PC4ME08

L	T	P	C
3	0	0	3

Thermal Engineering-I

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

Unit 1: I.C Engines

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

Unit 2: 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

Unit 1: 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

Unit 2: 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

Unit 1: 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

Unit 2: Compressors

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

Module IV

Unit 1: 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.

Unit 2: 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

Unit 1: Refrigeration

Mechanical refrigeration and types, units of refrigeration, air refrigeration system, details and principle of operation, applications of air refrigeration,

Unit 2: Vapour compression refrigeration systems

Vapour compression refrigeration systems, calculation of COP, effect of super heating and sub cooling, desired properties of refrigerants and common refrigerants, vapour absorption system, mechanical details, working principle, use of p-h charts for calculations

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”, Dhanpat Rai& Sons, 3rdEdition, 2008.
2.Pulkrabek, “Engineering Fundamentals of IC Engines”, Pearson Education, 2ndEdition, 2008.
3.Rudramoorthy, “Thermal Engineering”, Tata McGraw-Hill, 5thEdition 2003.
4.C. P. Arora, “Refrigeration and Air Conditioning”, Tata McGraw-Hill Education, 3rdEdition, 2013

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

CO-PO/PSO Mapping Chart

(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**
CO1	2	3				2	2						3	3
CO2	3	3	2										3	
CO3	3	3											3	
CO4	1	3	2										3	

B.Tech II Year–IV Sem

Subject Code: 21PC4ME09

L	T	P	C
3	0	0	3

FLUID MECHANICS AND HYDRAULIC MACHINERY

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

Unit 1: Fluid Statics

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

Unit 2: Pressure Measurement

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

Module II

Unit 1: 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.

Unit 2: Fluid Dynamics

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

Module III

Unit 1: 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.

Unit 2: 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

Unit 1: 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.

Unit 2: Hydraulic Turbines

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

Unit 1: Centrifugal Pumps

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

Unit 2: 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 and Hydraulic Machines by Rajput.

Reference Books:

1.Fluid Mechanics and Fluid Power Engineering by D.S. Kumar, Kotaria & Sons.
2. Fluid Mechanics and Machinery by D. Rama Durgaiah, New Age International.
3. 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:

- 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.

CO-PO/PSO Mapping Chart (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**
CO1	3	2											2	
CO2	3	2											2	
CO3	3	2											2	
CO4	3	2											2	

B.Tech II Year–IV Sem

Subject Code: 21PC4ME10

L	T	P	C
0	0	2	1

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.

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.

Reference Books:

Machine Drawing / N.D. Bhatt / Charotar

Machine Drawing / Ajeet Singh / Mc Graw Hill

Online references:

https://nptel.ac.in/courses/112/103/112103019/

Course Outcomes:

- CO1: Analysis of complex design systems related to mechanical Engineering.
- CO2: Making use of appropriate laboratory tools and design innovative methods.
- CO3: To enhance the ability of students to work as teams.
- CO4: Improving skills to adopt modern methods in mechanical engineering as continuous improvement.

CO-PO/PSO Mapping Chart **(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**
CO1	3													
CO2	3												2	
CO3	3								3				2	
CO4	3				3									

B.Tech II Year–IV Sem

Subject Code: 21PC4ME11

L	T	P	C
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: All the 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

Course Outcomes:

Students will 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.

CO-PO/PSO Mapping Chart (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**
CO1	3	2											2	
CO2	3	2											2	
CO3	3	2											2	
CO4	3	2											2	

B.Tech II Year–IV Sem	**L**	**T**	**P**	**C**
Subject Code: 21PR4ME01	**0**	**0**	**3**	**1.5**

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 SOILD 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. **30 marks: Continuous Internal Evaluation**
2. **70 Marks: External Evaluation.**

CO-PO/PSO Mapping Chart (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**
CO1	3	2			3				3	3				
CO2	3	2			3				3	3			2	2
CO3	3	2			3				3	3			2	2
CO4	3	2			3				3	3				

B.Tech II Year–IV Sem	L	T	P	C
Subject Code: 21ES4MT07	3	1	0	4

STATISTICAL METHODS & COMPLEX VARIABLES

(Mechanical Engineering)

Pre-requisite: Basic knowledge of set and relations theory, permutations, combinations, Venn diagrams, mean, median, mode and Complex numbers.

Course Objectives: To learn

- The ideas of probability and random variables and various discrete and continuous probability distributions and their properties.
- The statistical methods of studying data samples.
- Differentiation and integration of complex valued functions.
- Evaluation of integrals using Cauchy's integral formula and Cauchy's residue theorem.
- Expansion of complex functions using Taylor's and Laurent's series.

MODULE I

Unit 1: PROBABILITY

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

Unit 2: 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

Unit 1: DISCRETE DISTRIBUTIONS

Uniform Distribution, Binomial Distribution, Poisson distribution and statistical constants of these distributions using moment generating function.

Unit 2: CONTINUOUS DISTRIBUTIONS

Uniform Distribution, Normal Distribution and statistical constants of these distributions using moment generating function.

MODULE III

Unit 1: TESTS OF HYPOTHESES

Null & Alternative Hypothesis, Critical region, Type I and Type II errors, level of significance, one tail, two-tail tests.

Unit 2: TEST OF SIGNIFICANCE

Large sample test for single mean, difference of means, single proportion, difference of proportions, small sample tests: Test for single mean, difference of means.

MODULE IV

Unit 1: COMPLEX FUNCTIONS

Limit, Continuity and Differentiation of Complex functions.

Unit 2: 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

Unit 1: COMPLEX INTEGRALS

Line integral, Cauchy's theorem, Cauchy's Integral formula, Zeros of analytic functions, Singularities.

Unit 2: SERIES

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 on real axis).Conformal mapping and Mobius Transformations.

Text Books:

1. Introduction to Probability and Statistics for Engineers and Scientists, Sheldon M. Ross, 6th 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 Grinsted, 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. 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. 3.Introduction to Probability by Charles M Grinsted, J Laurie Snell https://1lib.in/book/556778/1a0fc2
4. 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: Solve the probability and the probability distribution function of random variables.
CO2: Evaluate random processes which occur in engineering applications governed by the Binomial, Poisson, Normal and Exponential distributions.
CO3: Apply Inferential Statistics to make predictions or judgments about the population from which the sample data is drawn.
CO4: Analyze the complex function with reference to their analyticity, integration of complex functions by Cauchy's integral and residue theorems, Taylor's and Laurent's series.

CO-PO/PSO Mapping Chart (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	2			1							
CO2	3	2			1							
CO3	3	1			1							
CO4	3	1			1							

B.Tech II Year–IV Sem	L	T	P	C
Subject Code: 21ES4CS03	3	0	0	3

PYTHON PROGRAMMING
(Common To All Branches)

Pre-requisite: Programming for Problem solving Using C

Course Objectives:
1. Acquire programming skills in core Python.
2. Acquire Object-oriented programming skills in Python.
3. Develop the skill of designing graphical-user interfaces (GUI) in Python.
4. Develop the ability to write database applications in Python.

Course Outcomes:
1. Understand operators, precedence of operators, associatively while evaluating expressions in program statements.
2. Distinguish the capabilities of procedural as well as object-oriented programming in Python and demonstrate the same in real world scenario.
3. Demonstrate indexing and slicing mechanisms for extracting a portion of data in a sequence.
4. Extend the knowledge of Python programming to build successful career in software development.

Module I
Python Basics, Objects- Python Objects, Standard Types, Other Built-in Types, Internal Types, Standard Type Operators, Standard Type Built-in Functions, Categorizing the Standard Types, Unsupported Types
Numbers - Introduction to Numbers, Integers, Floating Point Real Numbers, Complex Numbers, Operators, Sequences - Strings, Lists, and Tuples, Mapping and Set Types

Module II
Conditional Statements: Selection/Conditional Branching Statements: if, if-else, nested if, if-elif-else statement(s).
Iterative Statements – while and for loop, Nested loops, break and continue statement, pass Statement, else Statement used with loops.

Module III
Functions: Communicating with functions, Variable Scope and lifetime, return statement, Types of arguments, Lambda functions, and Recursive functions
Classes and Objects – Defining Classes, Creating Objects, Data Abstraction and Hiding through Classes, Class Method and self-Argument, Class variables and Object variables, __init()__ and __del__() method.

Module IV
FILES: File Objects, File Built-in Function [open ()], File Built-in Methods, File Built-in Attributes, Standard Files, Command-line Arguments.
Exceptions: Exceptions in Python, Detecting and Handling Exceptions, Context Management, , Raising Exceptions, Related Modules
Regular Expressions: Introduction, Special Symbols and Characters, Res and Python

Module V

Multithreaded Programming: Introduction, Threads and Processes, Python, Threads, and the Global Interpreter Lock, Thread Module, Threading Module, Related Modules

GUI Programming: Introduction, Tkinter and Python Programming, Brief Tour of Other GUIs, Related Modules and Other GUIs

Text Books:

1. Reema Thareja, "Python Programming - Using Problem Solving Approach", Oxford Press, 1st Edition, 2017.
2. Philips, "Python 3 Object Oriented Programming", PACKT Publishing, 2nd Edition, 2015.

Reference Books:

1. Yashavant Kanetkar, Aditya Kanetkar, "Let Us Python", BPB Publications, 2nd Edition, 2019.
2. Martin C. Brown, "Python: The Complete Reference", McGraw Hill, Indian Edition, 2018.
3. Michael H.Goldwasser, David Letscher, "Object Oriented Programming in Python", Prentice Hall, 1st Edition, 2007.

CO-PO/PSO Mapping

CO-PO/PSO Mapping Chart (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**	**PSO 3**
CO1			M										L		
CO2			M										L		
CO3					M								L		
CO4					M								L		

B.Tech IIYear–IV Sem	L	T	P	C
Subject Code: 21ES4CS04	0	0	3	1.5

PYTHON PROGRAMMING LAB
(Common To All Branches)

Prerequisite: Basic Programming Skills.

Course Objectives:

To learn the fundamentals of computers.

1. Acquire programming skills in core Python.
2. Acquire Object-oriented programming skills in Python.
3. Develop the skill of designing graphical-user interfaces (GUI) in Python.
4. Develop the ability to write database applications in Python.

Course Outcomes:

1. Acquire programming skills in core Python.
2. Acquire Object-oriented programming skills in Python.
3. Develop the skill of designing graphical-user interfaces (GUI) in Python.
4. Develop the ability to write database applications in Python.

List of Experiments:

Experiment – 1: OPERATORS

a. Read a list of numbers and write a program to check whether a particular element is present or not using membership operators.
b. Read your name and age and write a program to display the year in which you will turn 100 years old.

Experiment – 2: CONTROL STRUCTURES

a. Read your email id and write a program to display the no of vowels, consonants, digits and white spaces in it using if…elif…else statement.
b. Write a Program to find the sum of a Series 1/1! + 2/2! + 3/3! + 4/4! +…….+ n/n!. (Input :n = 5, Output : 2.70833)

Experiment – 3: LIST

a. Read a list of numbers and print the numbers divisible by x but not by y (Assume x = 4 and y = 5).
b. Read a list of numbers and print the sum of odd integers and even integers from the list.(Ex: [23, 10, 15, 14, 63], odd numbers sum = 101, even numbers sum = 24)

Experiment – 4: TUPLE

a. Given a list of tuples. Write a program to find tuples which have all elements divisible by K from a list of tuples. test_list = [(6, 24, 12), (60, 12, 6), (12, 18, 21)], K = 6, Output : [(6, 24, 12), (60, 12, 6)]
b. Given a list of tuples. Write a program to filter all uppercase characters tuples from given list of tuples. (Input: test_list = [("GFG", "IS", "BEST"), ("GFg", "AVERAGE"), ("GfG",), ("Gfg", "CS")], Output : [('GFG', 'IS', 'BEST')]).

Experiment – 5: SET

a. Write a program to generate and print a dictionary that contains a number (between 1 and n) in the form (x, x*x).
b. Write a program to perform union, intersection and difference using Set A and Set B.

Experiment – 6: DICTIONARY

a. Write a program to do the following operations:
   i. Create a empty dictionary with dict( ) method
   ii. Add elements one at a time
   iii. Update existing key's value
   iv. Access an element using a key and also get( ) method
   v. Deleting a key value using del( ) method
b. Write a program to create a dictionary and apply the following methods:
   i. pop( ) method
   ii. pop item( ) method
   iii. clear( ) method

Experiment – 7: STRINGS

a. Given a string, write a program to check if the string is symmetrical and palindrome or not. A string is said to be symmetrical if both the halves of the string are the same and a string is said to be a palindrome string if one half of the string is the reverse of the other half or if a string appears same when read forward or backward.
b. Write a program to read a string and count the number of vowel letters and print all letters except 'e' and's'.

Experiment – 8: USER DEFINED FUNCTIONS

a. Write a function merge_dict(dict1, dict2) to merge two Python dictionaries.
b. Given a list of n elements, write a linear_search() function to search a given element x in a list.

Experiment – 9: BUILT-IN FUNCTIONS

a. Write a program to demonstrate the working of built-in statistical functions mean ( ), mode ( ), median () by importing statistics library.
b. Write a program to demonstrate the working of built-in trigonometric functions sin ( ), cos ( ),
   tan ( ), hypot ( ), degrees ( ), radians ( ) by importing math module.

Experiment – 10: **CLASS AND OBJECTS**

a. Write a program to create a Bank Account class. Your class should support the following methods for
   i) Deposit
   ii) Withdraw
   iii) Get Balance
   iv) Pin Change
b. Write a program to create an employee class and store the employee name, id, age, and salary using the constructor. Display the employee details by invoking employee_info () method and also using dictionary (__dict__).

Reference Books:

1. Michael H Goldwasser, David Letscher, "Object Oriented Programming in Python", Prentice Hall, 1st Edition, 2007.
2. Yashavant Kanetkar, Aditya Kanetkar, "Let us Python", BPB publication, 1st Edition, 2019.
3. Ashok Kamthane, Amit Kamthane, "Programming and Problem Solving with Python", McGraw Hill Education (India) Private Limited, 2018.

CO-PO/PSO Mapping Chart:

CO-PO/PSO Mapping Chart (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**	**PSO 3**
CO1			1										1		
CO2		1											1		
CO3					2								1		
CO4					2								1		