ME 3.1 APPLIED THERMODYNAMICS – I

Subject Code	Name of the Subject	Scheme of Instruction Hrs/ week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	P	O	Total
ME 3.1	Applied Thermodynamics - I	3	--	2	3	100	25	--	--	25	**150**

Course Objectives:

1. This course aims to provide a good platform to mechanical engineering students to understand, model and appreciate concept of dynamics involved in thermal energy transformation.
2. To prepare them to carry out experimental investigation and analysis at later stages of graduation.

Course Outcomes:

1. To apply the knowledge of mathematics, science and engineering fundamentals to model the energy conversion phenomenon.
2. To identify and formulate power production based on the fundamentals laws of thermal engineering.
3. To instill upon to envisage appropriate experiments related to heat engines.
4. To investigate the effectiveness of energy conversion process in mechanical power generation for the benefit of mankind.
5. To appreciate concepts learnt in fundamentals laws of thermodynamics from which learning ideas how to sustain in energy crisis and think beyond curriculum in the field of alternative and renewable sources of energy.
6. To communicate effectively the concepts of internal combustion engines and try to think beyond curriculum in alternative sources of energy.

UNIT - 1 **(12 Hours)**

FIRST LAW OF THERMODYNAMICS

Basic Concepts: Thermodynamic systems, properties with measurements – Zeroth law of thermodynamics, states, and processes- definition and classification, Thermodynamic work and heat – Classification and sign convention. point and path functions.

Statement for control mass undergoing cycle, corollaries – For a process, Perpetual motion machine of First kind (PMMFK/PMM-I)). Internal energy and Enthalpy – specific heats, application of First law to standard reversible processes – Isochoric, Isobaric, Iso-thermal, reversible adiabatic and Polytropic.

Control volume analysis, First Law applied to steady flow processes (emphasizing on derivation for energy equations)- Bernoulli and Euler's equations as a limiting form, applications including throttling process, comparison between steady flow and displacement works.

UNIT - 2 (12 Hours)

SECOND LAW OF THERMODYNAMICS

Limitations of First law of thermodynamics, Cyclic devices, Directional constraints. Thermal Energy reservoirs. Heat engines, refrigerators/heat pump, Statements – Kelvin- Planck & Clausius, Mathematical interpretations with efficiency, COP, Ton of Refrigeration, Equivalence of statements with illustrations, Perpetual motion machine of second kind (PMMSK/PMM-II). Reversibility and irreversibility – causes and conditions. Carnot Theorems, Absolute temperature scale.

Entropy: Clausius Inequality, Entropy – property, Temperature entropy plane – all standard reversible processes (including polytropic process) with calculation for entropy change on T-S plane, Problem solving & solution procedure. Entropy change - irreversible process, flow processes, concept of lost work, entropy generation – applications, entropy as a measure of disorder.

UNIT - 3 (12 Hours)

MODELLING OF BASIC ENERGY CONVERSION CYCLES

Air standard assumptions, Overview of reciprocating engines, Air standard cycles for reciprocating engines – Otto, Diesel & dual, Criteria for comparison & comparative analysis, Derivation for efficiency, Mean effective pressure(MEP) & Carnot efficiency, calculation of Heat transfer at mean temperature.

Stirling and Ericsson cycle: Need, Derivation of efficiency. First law and second law applied to cycles.

Brayton Cycle: Ideal cycle for gas turbine engines, Deviation of actual cycle, Enhancement – with regeneration, with reheating, with intercooling and combination, First Law and second law applied to these cycles.

UNIT - 4 (12 Hours)

REACTIVE SYSTEMS AND JET PROPULSION CYCLES

Fuels and Combustion: Theoretical & actual processes, enthalpy of formation, first law of reacting system – steady flow and closed systems, adiabatic flame temperature, Heat of reaction- Third law of Thermodynamics, Second law analysis, entropy change of reacting systems.

Jet Propulsion: Theory, Classification of jet engines, Thermodynamic cycle - Ram-jet, turbo-jet, turbo prop, I and II law analysis on each cycle, thermal efficiency, Carnot efficiency and propulsive efficiency, Derivation & calculations.

Rocket Propulsion: Brief evolution & theory of operation, Thermodynamics involved in propulsion, Basic rocket propulsion air cycle analysis.

Recommended Readings:

1. Y. A. Cengel, M. A. Boles; Thermodynamics – An Engineering Approach; Tata McGraw Hill Education Pvt. Ltd. New Delhi.4th Ed; 2012.
2. P. K Nag; Engineering Thermodynamics; Tata McGraw Hill Education Pvt. Ltd.; New Delhi.4th Ed.; 2008.
3. P. W Gill, J. H. Smith., E. J. Ziurys; Fundamentals of Combustion Engines; Oxford & IBH Publishing Co. Pvt. Ltd.; 4th revised Ed.;1967.
4. G. V. Wylen; R. Sonntag, C. Borgnakke; Fundamentals of Classical Thermodynamics; John Wiley & Sons, 4th Ed.; 1996.
5. G. Rogers, Y. Mayhew; Engineering Thermodynamics-Work and Heat Transfer; Pearson Education Ltd., 7th Ed.; 2012.
6. J. B. Jones, R. E. Dungan; Engineering Thermodynamics; Prentice Hall of India Pvt. Ltd., New Delhi, Eastern Economy Ed.; 1996.
7. E. Radhakrishna; Fundamentals of Engineering Thermodynamics; Prentice Hall of India Pvt. Ltd., New Delhi, 2nd Ed.; 2011.

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments)

To investigate and ascertain the conformance of:

1. The first law of thermodynamics on petrol engine.
2. The second law of thermodynamics on petrol engine.
3. The first law of thermodynamics on diesel engine.
4. The second law of thermodynamics on diesel engine.
5. First law and second law on reactive systems
6. Cycle analysis on gas turbine
7. First law analysis on gas turbine/jet propulsion
8. Second law analysis on gas turbine/jet propulsion
9. First law analysis of heat pump.
10. Second law analysis of heat pump

ME 3.2 MACHINE DRAWING

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	P	O	Total
ME 3.2	Machine Drawing	2	--	3	4	100	25	25	--	--	**150**

Course Objectives:

1. To visualize mechanical component and convert it into a drawing.
2. To gain knowledge in two dimensional drafting.
3. To understand conventional symbols used in machining and mechanical details as per IS.
4. To assemble and disassemble the mechanical parts.

Course Outcomes:

After the successful completion of the course, the student should be able to

1. Visualize and draw intersections of various solids.
2. Understand and draw various types of joints and power transmitting joints.
3. Explain concepts and applications of limits, fits and tolerances.
4. Draw assembly and part drawings of various mechanical components.

UNIT-1 (8 hours)

Preliminaries: Introduction to machine drawing, conventional representation of machine components, materials, springs & gears, indication of surface texture.

Fundamentals: Multi-view projection, sectional views.

Intersection of Solids: Cylinder & cylinder, cylinder & cone, cylinder & prism.

Introduction to AutoCAD: AutoCAD basics.

UNIT-2 (8 hours)

Joints

Threaded Fasteners & Joints: Screw thread nomenclature, types of threads, nut, bolt and washer, locking arrangements of nuts, foundation bolts (freehand sketches only)

Keys, Cotters & Pin Joints: Keys, cotter joints, socket & pigot joint, sleeve & cotter joints, jib & cotter joint, knuckle joint (freehand sketches only)

Welded Joints: Types of welded joints, welding symbols

Rivetted Joints: Introduction, classification, caulking & fullering for rivets
Pipe joints (freehand sketches only)

Power Transmission Units: Shaft couplings, Shaft bearings (freehand sketches only)

Limits, Fits & Tolerances: Terms related to dimensional tolerances, Types of tolerances, Systems of dimensional tolerances & fits, Calculation of fundamental deviations and tolerances, Types of fits, Geometrical tolerances

UNIT-3 (8 hours)

Assembly Drawings with Sectioning and Bill of Materials
Valves: Three-way stop valve, blow-off valve, steam stop valve, Ramsbottom safety valve, non-return valve etc.

Bearings: Plummer block, pedestal bearing, footstep bearing etc.

Miscellaneous Parts: Lathe tool post, Lathe and Milling machine tail Stock, Screw Jack, Pipe View, Drill Jig, Crane hook, connecting rod etc.

UNIT-4 (8 hours)

Part Drawings
Preparation of detail drawing of above parts listed in UNIT 3.
Drawing Sheets on details must include dimensional as well as geometrical tolerances and surface finish requirements

Recommended Readings:

1. N. Siddheshwar, P. Kannaiah, V. V. S. Sastry; Machine Drawing; Tata-McGraw Hill.
2. K. C. John; A text book of Machine Drawing; PHI Learning Pvt. Ltd., New Delhi.
3. N. D. Bhat; Machine Drawing; Charotar Publishing Company.
4. IS Code SP 46 -1988
5. P. S. Gill; Machine Drawing; SK Kataria & Sons, New Delhi.
6. K. L. Narayana; P. Kannaiah, K. Venkata Reddy; Machine Drawing; New Age International Publishers.
7. K. R. Gopalkrishna; Machine Drawing; Subhash Publications.

List of Practicals:

During practicals, following should be completed and submitted within given deadline. (The Term Work marks to be awarded based on the assessment of the completed sheets, soft copy of drawing using drafting software and the sketch book,)

1. At least THREE sheets on assembly and THREE sheets on disassembly should be done.
2. At least ONE drawing on assembly and ONE drawing on disassembly should be done using AutoCAD or any other standard drafting software
3. Sketch book should comprise of free hand sketches of Joints and Power Transmission Units (Unit 2)

ME 3.3 FLUID MECHANICS

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	P	O	Total
ME 3.3	Fluid Mechanics	3	1	2	3	100	25	--	25	--	**150**

Course Objectives:

1. To understand fluids, its properties and fluid statics.
2. To analyze Kinematics and Dynamics of fluid flow.
3. To understand the concept of buoyancy and viscous flow.
4. To study boundary layer concept.

Course Outcomes:

The student after undergoing this course will be able to:

1. Understand the basic concept of fluid flow and properties of fluids.
2. Understand the principles of fluid statics, kinematics and dynamics.
3. Analyze fluid flow problems with the application of the momentum and energy equations.
4. Understand concept of buoyancy, viscosity and importance of viscosity in real flows.
5. Perform dimensional analysis for problems in fluid mechanics.
6. Understand the concept of boundary layer formation.

UNIT - 1 (12 Hours)

Properties of Fluids: Basic concepts and definitions, Classification and properties of fluids, Surface tension and capillarity, Compressibility and bulk modulus.

Fluid Statics: Liquid pressure and its types, Pascal's law, Pressure variation in a static fluid, Measurement of pressure, Manometers (simple), Differential manometers, Mechanical gauges, Pressure at a point in a compressible fluid.

Hydrostatic Forces on Surfaces: Total pressure, Center of pressure on vertical submerged surfaces in liquid, Total pressure, Center of pressure on horizontal & inclined submerged surfaces in liquid, Hydrostatic paradox.

UNIT - 2 (12 Hours)

Fluid Kinematics & Dynamics: Types of fluid flow, Discharge, continuity equation, Continuity equation in 3D, Equations of motion, Euler's equation, Bernoulli's equation, Practical application of Bernoulli's equation, Impulse momentum equation, Kinetic energy and momentum correction factor, Bernoulli's equation for compressible flow for isothermal case.

Flow through Pipes: Loss of head in pipes, major, minor losses, Darcy's weisbach equation, Hydraulic gradient and total energy line, Flow through siphon , Equivalent pipe -series & parallel pipes, Flow through nozzle, Water hammer in pipes.

UNIT - 3 (12 Hours)

Buoyancy: Buoyancy, Centre of Buoyancy, Conditions of equilibrium of floating & submerged bodies, Meta-centre and Metacentric height.

Viscous Flow: Introduction, Reynold's experiment, Flow of viscous fluid through circular pipe-Hagen Poiseuille formula, Flow of viscous fluid between two parallel plates, Power absorbed in viscous flow: Viscous resistance of journal bearing, Foot-step bearings, Collar bearings, Loss of head due to friction in viscous flow, Movement of piston in dash pot.

UNIT - 4 (12 Hours)

Dimensional Analysis: Dimensions of physical properties, Dimensional homogeneity, Buckingham's pi theorem, Raleigh's method, Important dimensionless numbers.

Boundary layer: Laminar and turbulent boundary, Laminar sub layer, Boundary layer thickness, Energy thickness and momentum thickness, Drag force on a flat plate due to boundary layer, Total drag due to laminar and turbulent layers, Boundary layer separation and its control.

Recommended Readings:

1. R. K. Bansal; A textbook of Fluid Mechanics & Hydraulic machines; Laxmi Publications (p) Ltd; 2012.
2. R. W. Fox, P. J. Pritchard, A. T. McDonald; Introduction to Fluid Mechanics; Wiley India; 7/e.
3. P. N. Modi, S. M. Seth; Hydraulics & Fluid Mechanics including Hydraulic Machines; Standard Book House, New Delhi; 2009.
4. Y. A. Cengel, J. M. Cimbala; Fluid Mechanics: Fundamentals & Applications; TMH, New Delhi; 2/e.

5. D. S. Kumar; Fluid Mechanics & Fluid Power Engineering; S. K. Kataria & sons, New Delhi; 2008.

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments)

1. Verification of Bernoulli's Theorem
2. To determine the coefficient of discharge of a venturimeter
3. To determine the coefficient of discharge of a orifice meter
4. Calibration of a rotameter
5. To determine the coefficient of discharge of a mouthpiece
6. To determine the coefficient of discharge of a V- notch
7. To determine the coefficient of discharge of a Rectangular- notch
8. To calculate friction factor in Helical coil
9. To determine coefficient of friction in pipe set-up
10. To find minor losses in pipes
11. To determine the coefficient of discharge of a flow nozzle
12. Demonstration of Reynold's Experiment
13. Determination of metacentric height of a ship model
14. Determination of the centre of pressure of a plane surface being subjected to hydrostatic thrust
15. Experimental verification of momentum equation
16. Study of boundary layer velocity profile

ME 3.4 ENGINEERING MATERIALS SCIENCE AND METALLURGY

Subject Code	Name of the Subject	Scheme of Instruction Hrs/ week			Scheme of Examination						
					Th Duration (Hrs)	Marks					
		L	T	P		Th	S	TW	P	O	Total
ME 3.4	Engineering Materials Science and Metallurgy	3	--	2	3	100	25	--	25	--	**150**

Course Objectives:

1. Provide a fundamental knowledge about common engineering materials - metals, ceramics, polymers and composites and the methods of observing, measuring and interpreting these properties, their usage, which are important in engineering design and manufacture.
2. Give familiarity with various characteristics and structure - property relationships and also thermal processing of metals
3. Provide proficiency and confidence in making judicial material choices for engineering applications.

Course Outcomes:

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

1. Describe crystal structures and understand the impacts of defects at the atomic and microstructure scales.
2. Interpret phase diagrams, understand the concepts of solid solution and solubility limits, and be able to predict the development of microstructures and impacts of phase transformations.
3. Comprehend the impact of structure of materials on observed properties.
4. Gain knowledge on different class of materials and their applications
5. Gain laboratory experience in the area of testing of mechanical properties of materials

UNIT - 1 (12 Hours)

Crystal Structure: Unit cell, Space lattices and Crystal structures, Packing efficiency, Miller indices for planes and directions, Linear and planar density.

Crystal Defects: Point defects-vacancy, interstitial and foreign impurities, Schottky and Frenkel defects. Line defects- edge and screw dislocations, burgers vector, Surface defects- low and high angle grain boundaries, tilt, twist and twin boundaries.

Dislocation Theory and Plastic Deformation: Dislocation Motion, Intersection of dislocations– jogs& kinks, Multiplication of dislocations, Energy of dislocations.

Plastic Deformation: Deformation by slip, Slip in a perfect lattices, Critical resolved shear stress for slip, Slip by dislocation movement, Slip systems, Deformation by twinning, strain hardening, recovery, recrystallization and grain growth.

UNIT - 2 (12 Hours)

Fracture: Types of fracture in metals, ductile fracture, theoretical cohesive strength of metals, Griffith theory of brittle fracture, ductile-brittle transition temperature.
Mechanical Testing of Materials: Tensile, impact, hardness, fatigue, creep and formability tests.

Phase Diagrams: Cooling Curves, Gibb's phase rule, Binary phase diagrams, Interpretation of phase diagram, Lever rule.

Iron-Carbon Phase Diagrams: Phases in iron-carbon diagram, definition of structures, invariant reactions, Development of Microstructure during slow cooling, critical temperature lines, isothermal transformations diagram, transformation on continuous cooling.

UNIT - 3 (12 Hours)

Heat treatment of steels: Annealing, Normalizing, Hardening, Tempering, hardenability, Jominy end quench test. Case hardening of steels - Carburizing, Cyaniding, Nitriding, Induction and Flame hardening. Heat treatment of steels of non-ferrous metals and alloys by precipitation hardening.

Metallography: Metallography of steel, cast iron, brass and bronze, sample preparation, etching. Construction and working of Optical Microscope, TEM and SEM.

Powder Metallurgy: Powder manufacture, blending or mixing, compacting, sintering, secondary operations, applications, advantages and limitations.

Non Destructive Testing of Materials: X - Ray and Gamma Radiography, Magnetic particle inspection, Fluorescent penetrant test, Ultrasonic inspection, Eddy current inspection.

UNIT - 4 (12 Hours)

Polymeric Materials: Characteristics, Processing and applications of polymeric materials.

Ceramic Materials: Structure, Properties, Processing and application of ceramic materials

Composite Materials: Classification, Particle reinforced composites - Particulate and Dispersion strengthened composites, Fibre reinforced composites – Matrix & Fibre phases, influence of fibre characteristics, and elastics modulus under iso-stress and iso-strain condition.

Alloy Steels: Purpose of alloying, effect of alloying elements, effect of common alloying element and their applications.

Tool Steels: Classification, properties and typical applications.

Stainless Steels and Cast Irons: Classification, properties and applications.

Recommended Readings:

1. V. Raghavan; Elements of material science and engineering; PHI; Vth Edition.
2. Sydney H. Aver; Introduction to physical metallurgy; TMH; IInd Edition.
3. William D. Callister; Elements of material science and engineering; John Wiley & Sons, New York; IVth Edition.
4. George E. Dieter; Mechanical Metallurgy; TMH.
5. R. A. Higgins; Engineering Metallurgy; Viva Books; VI Edition

List of experiments:

(At least 8 experiments should be conducted from the list of experiments)

1. To draw the stress-strain curve and calculate the elastic limit, yield strength, ultimate tensile strength, percentage of elongation, percentage of reduction in area, toughness and resilience of the given metal.
2. To measure the hardness of the given material using Brinell/Rockwell/Vicker's Hardness testing machine.
3. To measure the impact strength and notch sensitivity of the given metal.
4. To study the creep behavior and determine the steady state creep rate of the given specimen
5. To determine the capacity of the material to withstand repeated cyclic stress through fatigue test.
6. To determine the ductile - brittle transition temperature of the given metal.
7. To determine the formability of the given metal using cupping test.
8. To study the microstructure of (a) mild steel (b) brass (c) cast iron.
9. To detect the presence of cracks/flaws in the given metal piece by magnetic particle crack detection method.

10. To detect the presence of cracks/flaws in the given metal piece by dye penetrant test.
11. To determine the hardenability of the given specimen using Jominy End Quench test.
12. To study the change of microstructure and property during heat treatment of the given specimen.
13. To determine the wear constant of the given material using wear testing machine
14. To determine the torsional strength and angle of twist of the given specimen

ME 3.5 ELECTRICAL TECHNOLOGY

Subject Code	Name of the Subject	Scheme of Instruction Hrs/ week			Scheme of Examination						
					Th Duration (Hrs)	Marks					
		L	T	P		Th.	S	TW	P	O	Total
ME 3.5	Electrical Technology	3	1	2	3	100	25	--	--	--	**125**

Course objectives:

1. To study the basic concepts involved in the operation of different types of electrical machines.
2. To analyze the different types of switching, controlling & protective devices.
3. To study the basic concepts of industrial heating & welding.
4. To study the usage of appropriate electrical measuring instruments.

Course Outcomes:

After the successful completion of this course, the student will be able to

1. Know the working of DC generators and DC motor.
2. Understand the details of Induction motors, synchro, servomotor, stepper motor.
3. Understand the working of Drives & braking, Switching & protective devices.
4. Know the details of Electrical measuring instruments, heating & welding.

UNIT - 1 (12 Hours)

D.C. Generator: Working principle, construction, generation of induced e.m.f., e..m.f. equation, types of generators, their voltage & current equations & their applications.

D.C. Motor: Working principle, voltage equation, concept of back e.m.f., torque equation, speed, classification of d.c. motors, electrical & mechanical characteristics of different types of d.c. motors, speed control, power flow diagram & different types of losses, Starter – its necessity, types of starters used – three point & four point starter only.

UNIT - 2 (12 Hours)

Induction Motors, Synchro, Servomotor, Stepper motor: Three phase induction motor: working principle, construction, slip, starting torque, torque under running condition, torque slip characteristics , power flow diagram, efficiency, methods used for staring- types of starters used their circuit diagram, working and application, methods used in speed control.

Single Phase Induction Motor: split phase types only their circuit diagram & working, torque slip characteristics.

Synchro: Types, construction, principle of operation & application.

Servomotor: Types, construction & working.

Stepper Motor: Types & their operation.

UNIT - 3 (12 Hours)

Drives: Concept of electric drives, four quadrant diagram of speed torque (characteristics, classification & application of drives. Braking of d.c. motors.

Switching Devices: Switch fuse units & their types, Contactors- electro magnetic type only, bimetallic (over current / thermal) relay- construction & working. Time delay relay – types, construction & working.

Circuit Breakers: MCB, MCCB& ELCB – block diagram, working, specifications & applications.

UNIT - 4 (12 Hours)

Electrical Measuring Instruments: Types of instruments used for a.c. & d.c. measurements of current , voltage , power& energy- construction & working of PMMC, MI instruments , Electro dynomometer type wattmeter& induction type energy meter.

Heating: Types – Resistance & high frequency heating- eddy current heating & dielectric heating w.r.t. their working principle & applications.

Welding: Electric arc welding & resistance welding – w.r.t. sourses used in welding- welding generators, types- construction & working, working Characteristics, welding transformer- its salient features, different types of current controllers used in welding. Block diagram of resistance welding set – its components & functions.

Recommended Readings:

1. I. J. Nagrath & D. P.Kothari; Electrical Machines; Tata McGraw Hill
2. P. S. Bimbhra; Electrical Machinery; Khanna Publishers
3. A. K. Sawhney; A Course in Electrical & Electronics Measurements & Instruments; Dhanpat Rai and Sons.
4. S. K. Pillai; A first course in Electrical Drives; New Age international (P) Ltd.
5. J. B. Gupta; Utilization of Electrical Power; S. K. Kataria and Sons.
6. V. K. Jain; Bulk Electric Supply and Distribution; Galgotia.

List of experiments:

(At least 8 experiments should be conducted from the list of experiments)

1. Speed control of d.c. shunt motor.
2. Speed control of slip ring induction motor
3. Performance characteristics of three phase squirrel cage induction motor
4. Starting of single phase split phase induction motor
5. Dynamic braking of d.c. shunt motor
6. Active & reactive power measurement in three phase resistive inductive load
7. Measurement of unknown resistance by Kelvity bridge
8. Measurement of insulation resistance by Megger
9. Measurement of error in a single phase energy meter
10. Study of 3 Point starter
11. Study of DOL and star delta starter
12. Study of Synchro
13. Study of Stepper Motor and Study of Servomotor

ME 3.6 ENGINEERING MATHEMATICS AND NUMERICAL TECHNIQUES

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	P	O	Total
ME 3.6	Engineering Mathematics and Numerical Techniques	4	--	--	3	100	25	--	--	--	**125**

Course Objectives:

1. To make students understand fundamentals of Mathematics necessary to formulate.
2. To solve and analyze engineering problems.

Course Outcomes:

The student after undergoing this course will be able to:

1. Compute the rank and inverse of a matrix and solve system of linear equations.
2. Compute Eigen values and Eigen vectors of a given matrix, apply Cayley Hamilton theorem.
3. Have a sound knowledge of Laplace transforms, Fourier transforms and its properties and apply it in solving integral and differential equations.
4. Express a function corresponding to objects following periodic phenomenon as a Fourier series in terms of sine and cosine functions.
5. Solve an algebraic or transcendental equation using an appropriate numerical method.
6. Understand interpolation and curve fitting.

UNIT - 1 **(16 Hours)**

Matrices: Types of matrices, Determinant, inverse of matrix, Elementary transformations, Elementary matrices, Rank of matrix, Reduction to normal form, Canonical form, Rank using elementary transformation.

Linear independence and dependence of vectors, System of the form AX = 0, and AX = B, and their solutions.

Eigen values, Eigen vectors with properties, Cayley-Hamilton theorem with its applications, minimal polynomial, Diagonalization.

UNIT - 2 **(16 Hours)**

Laplace Transforms: Definition. Existence conditions, properties, inverse Laplace transforms. Laplace transform of periodic functions, Convolution theorem, Laplace

transform of Dirac-Delta function, Application of Laplace transforms in solving linear differential equations with initial conditions and system of linear simultaneous differential equations.

UNIT - 3 (16 Hours)

Fourier Series : Periodic functions, Trigonometric series, Euler's formulae, Dirichlet's condition, Even and odd functions, Half range series, Parseval's identity.

Fourier Transforms: Definition of Fourier transforms, inverse Fourier transforms, properties, Fourier sine and cosine transforms, convolution theorem , application to solving integral equations.

UNIT - 4 (16 Hours)

Solutions of Equations: Solution of non-linear equations of single variable using Bisection method, False position method, Newton-Raphson method, Secant method, Order of convergence of these methods.

Finite difference and interpolation : Forward, Backward, Central, Divided differences, Difference tables, Newton Forward & backward difference interpolation, Lagrange's interpolation, Newton divided difference interpolation, Stirling's and Bessel's central difference interpolation formula.

Recommended Readings:

1. B. S. Grewal; Higher Engineering Mathematics; Khanna Publications, New Delhi.
2. B. S. Grewal; Numerical Methods; Khanna Publications
3. Veerarajan; Engineering Mathematics; Tata McGraw Hill Publications.
4. Erwin Kreyzing; Advanced Engineering Mathematics; Wiley India.
5. P. Kandasamy; Engineering Mathematics; Chand & Co., New Delhi.
6. Srimanta Pal, Subodh C. Bhunia; Engineering Mathematics; Oxford University Press

ME 4.1 MECHANICS OF SOLIDS

Subject Code	Name of the Subject	Scheme of Instruction Hrs/ week			Scheme of Examination						
					Th Duration (Hrs)	Marks					
		L	T	P		Th	S	TW	P	O	Total
ME 4.1	Mechanics of Solids	4	1	--	3	100	25	--	--	25	**150**

Course Objectives:

1. To know variety of stresses, strain and deformation due to external loads
2. To perform Two Dimensional Stress and Strain Analysis.
3. To study the behavioral pattern of beams, struts, columns, cylinders etc.
4. To study various failure theories and energy methods.

Course Outcomes:

The student after successfully undergoing this course will be able to

1. Learn fundamental concepts of Stress, Strain and deformation of solids and understand the applications of the strength of Materials approach to analyze simple structural elements, subjected to direct tension/compression/ shear loading, bending and torsion.
2. Understand the stress analyses for systems subjected to combined loading using different theories of failure.
3. Utilize the principles of deflection in beams.
4. Understand and use the principles of Energy Methods and its applications in structural solutions.
5. Understand and practice the concepts involved in structural stability.

UNIT - 1 (16 Hours)

Introduction: Review of engineering mechanics, static analysis of rigid systems. Introduction to Stress and Strain. Hooke's law, Poisson's ratio, Generalized Hooke's law, modulus of rigidity, bulk modulus, relation between material constants.

Uniaxial Deformation: Uniaxial tension and compression, temperature stresses, statically indeterminate systems.

Two Dimensional Stress and Strain Analysis: Analysis of two dimensional stress and strain, stress and strain analysis using Mohr's circle, strain gage rosettes.

UNIT - 2 (16 Hours)

Properties of Areas: Review of Moments of inertia and polar moment of Inertia, Product of inertia, Principal axes, Principal moments of inertia.

Beams: Bending moment and shear force, relation between them, sign convention, Bending stresses in beams- Flexure formula, Shear stresses in beams ,deflection of beams (using double integration method, singularity functions method and moment area method), statically indeterminate beams-propped and fixed beams.

UNIT - 3 (16 Hours)

Torsion: Torsion of solid and hollow circular shafts. Application of torsion to close and open coiled helical springs.

Theories of Failure: Various theories of failures and their limitations comparison and applications.

Combined Loading: Shafts subjected to bending moment and twisting moment, members subjected to bending and direct tension/ compression.

UNIT - 4 (16 Hours)

Struts and Columns: Struts and core of section, stability of columns, Euler's critical load, for different end conditions of column, empirical formulae for buckling load.

Introduction to Energy Methods: Strain energy under different loading conditions, Maxwell-Betti reciprocal theorem, Castigliano's theorems, deflection of structures using virtual load method. Theorem of minimum potential energy, complementary strain energy.

Thick and Thin Cylinders: Thin cylinders subjected to internal pressure, thick cylinders, Lame's equation.

Assignments:

Four assignments, one on each unit to be submitted by students within given deadline.

Recommended Readings:

1. S. Ramamrutham; Strength of Materials; Dhanpat Rai Publishing Co. (P) Ltd.
2. S. Sreenath; Strength of Materials; Tata McGraw-Hill Education.
3. Beer Ferdinand, Johnson E. Russel; Mechanics of Materials, Mc Graw Hill Books.
4. S. P. Timoshenko, D. H. Young; Elements of Strength of Materials, East West.
5. S. S. Bhavikatti; Strength of Materials; Vikas Publishing House Pvt Ltd.
6. R. C. Hibeller; Mechanics of materials; Pearson Press, India.

ME 4.2 ANALYSIS AND SYNTHESIS OF MECHANISMS

Subject Code	Name of the Subject	Scheme of Instruction Hrs/ week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	P	O	Total
ME 4.2	Analysis and Synthesis of Mechanisms	3	--	2	3	100	25	25	--	--	**150**

Course Objectives:

1. Aims at initiating, Mechanical Engineering students, in the area of synthesis and analysis of the mechanisms.
2. To analyze mechanical systems, in general.
3. Familiarize basic concepts of toothed gearing and kinematics of gear trains.

Course Outcomes:

After the successful completion of the course, the student will be able to:

1. Classify mechanisms and understand working of linkages
2. Understand Kinematics of rigid body.
3. Appreciate the velocity and acceleration analysis of mechanism.
4. Understand planar mechanisms and its kinematic synthesis.
5. Understand cams and gears.

UNIT - 1 (13 Hours)

Classification of Mechanisms: Basic kinematic concepts and definitions, degree of freedom, mobility, Kutzbach criterion, Gruebler's criterion, Grashof's Law, kinematic inversions of four-bar chain and slider crank chains, limit positions, mechanical advantage, transmission angle.

Description of some Common Linkages: Exact and approximate straight-line mechanism, steering gears, Geneva wheel mechanism, ratchet and pawl mechanism, toggle mechanism, pantograph and universal joint.

Kinematics of Rigid Body: Mathematical preliminaries on vectors & matrices, newtonian mechanics: work-energy and impulse-momentum principles. Fixed and moving reference frames, coordinate transformations, displacement, time derivatives, Angular velocity and acceleration, velocity and acceleration analysis using moving reference frame, chassel's theorem.

UNIT - 2 (11 Hours)

Velocity and Acceleration Analysis of Mechanisms: Displacement, velocity and acceleration analysis of mechanisms having higher and lower pairs, by graphical and analytical methods, instantaneous centre of velocity, Kennedy theorem, angular velocity ratio theorem, kinematic analysis by algebric methods, vector approach, Klein's construction, coriolis acceleration.

UNIT - 3 (13 Hours)

Kinematic Synthesis of Planar Mechanism: Task of synthesis and it's classification, synthesis of mechanism for three accuracy points using graphical and analytical techniques, Freudenstein's equation, Four bar coupler curves, Cognate linkages, Bloch's synthesis method, Practical consideration in mechanism synthesis.

Cams: Different types of Cams and followers and terminology for Cam- follower Mechanisms: follower motions : uniform velocity, uniform acceleration and retardation , SHM and cycloid, their comparison, graphical synthesis of cam profile for a given follower and it's motion, polynomials cam, synthesis of follower motion from the given follower acceleration variation with cam angle, pressure angle, and size of a cam, radius of curvature of the cam profile with roller follower to avoid undercutting, circular arc cam and tangent cams.

UNIT - 4 (11 Hours)

Gears and Gear Trains: Introduction, classification of gears, gear terminology, law of gearing, velocity of sliding, forms of teeth, cyclodial profile teeth, involutes profile teeth, path of contact, arc of the contact, numbers of pairs of teeth in contact, interference in involutes gears, minimum number of teeth, interference between rack and pinion, under cutting, method of avoiding interference, non- standard gears, comparison of cyclodial and involutes tooth forms.

Helical Gears: Terminology, Contact in two helical gears, contact ratio, comparison with spur gears.

Spiral Gears: Centre distance, velocity ratio, velocity of sliding, efficiency.

Worm and worm wheel: Terminology, application, efficiency.

Bevel Gears: Terminology, Tredgold's approximation.

Gear Trains: Analysis of simple, compound and epicyclic gear trains, automobile differential.

Recommended Readings:

1. Hamilton H. Mabie, F. Charles F.; Mechanism and dynamics of machinery; Rainholtz, John Wiley & Sons.
2. Jospeh E. Shigley, John J. Uicker Jr.; Theory of machines and Mechanisms; McGraw Hill International edition.
3. J. S. Rao, R. V. Dukkipati; Mechanism and Machine Theory; Wiley Eastern Limited.
4. S.S. Rattan; Theory of Machines; McGraw-Hill Education (India) Pvt Ltd.
5. Irving H. Shames; Engineering Mechanics; Prentice Hall of India Pvt. Ltd.
6. George H. Martin; Kinematics and Dynamics of Machines; McGraw-Hill international Book Company.

List of Practicals:

At least eight sheets to be completed on the following topics and submitted within given deadline. (The Term Work marks to be awarded based on the assessment of sheets completed)

1. Velocity Analysis
2. Acceleration Analysis
3. Cam profile
4. Synthesis of Mechanism

ME 4.3 MANUFACTURING TECHNOLOGY – I

Subject Code	Name of the Subject	Scheme of Instruction Hrs/ week			Scheme of Examination						
					Th Duration (Hrs)	Marks					
		L	T	P		Th	S	TW	P	O	Total
ME 4.3	Manufacturing Technology - I	3	--	2	3	100	25	--	25	--	**150**

Course Objectives:

1. Introduces basic processes followed for manufacturing different products like casting, metal forming, welding and plastic processing.
2. To understand how the different products are manufactured, their process details, and process parameters.
3. Prepares for mechanical engineering subjects like machine design, production planning and control, process engineering, etc.
4. To impart knowledge on basic manufacturing processes, which will be essential to understand advanced courses being offered in the area of manufacturing.
5. Introduces jigs and fixtures, their types and applications.

Course Outcomes:

After the successful completion of the course, the student will be able to:

1. Understand Casting process and related concepts.
2. Understand various types and applications of welding.
3. Appreciate various forming methods.
4. Understand processing and fabrication of plastics, ceramics, rubbers and elastomers.
5. Apply their knowledge on jigs and fixtures for different design of components.

UNIT - 1 (14 Hours)

Casting: Basic steps in making sand moulds, advantages of casting.

Pattern: Materials, types, pattern making allowances.

Core: Functions, types, core boxes, core making, core print, chaplets.

Moulding Sand: Moulding sand composition, general properties of moulding sand, sand testing (analytical treatment), green sand moulds, dry sand moulds.

Electric Furnaces for Melting Iron & Steel: Construction & operation.

Special Moulding and Casting Processes: CO2 Moulding, Shell Moulding, Plaster Mould Casting, Investment Casting, Centrifugal Casting- True, Semi and Centrifuging. Pressure Die Casting- Hot Chamber & Cold Chamber.

Casting Design: Pouring and Feeding, Progressive and Directional Solidification, Typical Gating System and its Elements, Gates and Risers. Casting Defects, Inspection and Testing of Casting.

UNIT - 2 (12 Hours)

Welding: Advantages, Classification, Types of Welds, Edge preparation for butt welds, Weldability and Metallurgical aspects of Welding.

Thermit Welding: Advantages, Disadvantages and Applications.

Gas Welding: Oxy-Acetylene Gas Welding, Types of Flames, Welding techniques, Welding equipments.

Arc Welding: Submerged Arc Welding(SAW), Tungsten Inert Gas Welding(TIG), Metal Inert Gas Welding(MIG), Metal Active Gas Welding(MAG), Electro-Slag Welding(ESW), Under Water Welding.

Resistance Welding: Spot, Seam Projection, Upset Butt, Flash Butt , Percussion , High Frequency.

Brazing and Soldering: Advantages and Applications.

Solid State Welding: Smith, Cold Pressure, Friction, Explosive, Diffusion.

Radiant Energy Welding: Laser Beam Welding (LBW), Electron Beam Welding (EBW), Ultrasonic Welding (USW).

UNIT - 3 (11 Hours)

Metal Forming: Theoretical basis and analysis of Metal Forming, Classification of Forming Processes, Hot and Cold Working, Explosive Forming, Electromagnetic Forming, Effect if variable on Metal Forming.

Rolling: Types of Rolling Mills, Roll Product Technology, Force and Power Calculation.

Forging: Classification- Open Die and Closed Die Forging, Hammer and Press Forging, Hand and Machine Forging, Equipments used, Force Calculation, Advantages and Disadvantages of Forging.

Extrusion: Direct, Indirect, Impact, Hydrostatic. Equipments Used. Drawing - Wire & Tube. Drawing Die and its Construction, Protective Metallic Coatings.

UNIT - 4 (11 Hours)

Fabrication of plastics: Casting- Hot Compression Moulding, Transfer Moulding, Injection Moulding, Blow Moulding, Extrusion, Thermoforming, Calendering, Machining and Joining of Plastics. Processing of Rubbers, Elastomers.

Jigs and fixtures: Introduction, Definitions, Elements, Types of Locaters, Clamps, Jig Bushes, Standard Jigs and Fixtures for Turning, Milling And Grinding. Design Principles of Location, Types of Jigs- Template, Plate, Channel, Leaf, Box. Types of Fixtures- Turning, Milling, and Grinding. Component based applications of Jigs and Fixtures.

Recommended Readings:

1. P. N. Rao; Manufacturing Technology, Volume- I; Tata McGraw Hill.
2. S. K. Hajra Choudhury, A. K. Hajra Choudhury, Nirjhar Roy; Elements of Workshop Technology, Volumes I; Media Promoters & Publishers Pvt. Ltd.
3. P. H. Joshi; Jigs And Fixtures; TMH.
4. R. K. Rajput; Manufacturing Technology (Manufacturing Processes); Laxmi Publications (P) Ltd.
5. P.C. Sharma; A text book of Production Technology (Manufacturing Processes); S. Chand & Company Ltd.
6. E. Paul DeGarmo, J.T. Black, Ronald A. Kohser; Materials and processes in Manufacturing; Prentice Hall India.
7. R. K. Jain; Production Technology; Khanna Publishers.
8. Suresh Dalela, R. Shankar; A text book of Production Technology; Galgotia Publications Pvt. Ltd.
9. R. S. Khurmi, J. K. Gupta; A text book of Workshop Technology (Manufacturing Processes); S. Chand & Company Ltd.

List of Practicals:

Practicals mentioned below are to be conducted in the workshop and the jobs are to be submitted for assessment at the end of the course.

1. Preparation of sand mould and casting
2. Smith forging (hot): One job.
3. Cold bending: One job
4. Arc / gas welding: To weld job completed by cold bending

ME 4.4 DIGITAL ELECTRONICS AND MICROCONTROLLER APPLICATIONS

Subject Code	Name of the Subject	Scheme of Instruction Hrs/ week			Scheme of Examination						
		L	T	P	Th Duration (Hrs)	Marks					
						Th	S	TW	P	O	Total
ME 4.4	Digital Electronics and Microcontroller Applications	3	--	2	3	100	25	--	25	--	**150**

Course Objectives:

1. To help students gain an understanding of the working of basic digital electronic circuits and microprocessor-based circuits.
2. To help students to understand electronic control of mechanical parts.
3. Prepare the students for advanced courses like Mechatronics, Fluid Power Control

Course Outcomes:

After the successful completion of the course, the student will be able to:

1. Understand Number systems and Boolean Algebra.
2. Appreciate the working of flip-flops, registers and counters.
3. Know in details 8051 microcontrollers.
4. Understand interfacing with 8051 based microcontroller system.

UNIT - 1 (12 Hours)

Study of Number Systems & Codes

Introduction to Decimal, Binary, Octal & Hexadecimal number systems & their interconversions.

Binary arithmetic, Signed binary numbers, Addition & subtraction using 1's & 2's complement method.

Introduction to BCD codes, Gray codes, Excess-3 codes & ASCII codes

Study of Boolean Algebra

Axioms, Laws& theorems of Boolean algebra, Reducing Boolean Expressions, Converting AOI to NAND/NOR Logic, Sum of products form (SOP), products of sum form (POS) of Boolean functions.

Study of Karnaugh Maps (K-maps) for 2, 3 & 4 variables only. Don't Care conditions.

UNIT - 2 (12 Hours)

Combinational Logic

Half Adder, Half Subtractor, Full Adder, Full subtractor, Encoders and Decoders; Multiplexers and Demultiplexers. BCD-to- 7 segment decoder.

Study of Flip Flops

Latch v/s Flip flop, Study of clocked RS flipflop, JK- flip flop, T-flip flop, D- flip flop & Master slave JK (MSJK) flip flop with their schematic symbol, truth table & excitation table. Triggering of flip-flops.

Study of Shift Registers

Study of Serial in serial out (SISO), Serial in parallel out (SIPO), Parallel n serial out (PISO), Parallel in parallel out (PIPO) shift registers.

Study of Counters

Asynchronous up counters, down counters & up/down counters (logic diagram& waveforms) Comparison between Asynchronous and Synchronous Counters. (No design problems)

UNIT - 3 (12 Hours)

8051 microcontroller architecture:

Comparison between Microprocessor & Microcontroller.

Hardware, input/output pins, Ports, external memory, counters and timers, serial data input and output, interrupts.

8051 instruction set& Programming

Addressing Modes

Data movement instruction: External Data move, Code memory Read-Only-Data moves, PUSH and POP opcodes, Data exchanges.

Logic operation: Bit and Byte level, Rotate and Swap.

(Simple Assembly Level Programs)

UNIT - 4 (12 Hours)

8051 instruction set & Programming:

Arithmetic operations: Flags, incrementing, decrementing, addition, subtraction, multiplication and division, decimal arithmetic.

Jump instruction: call, subroutine Interrupts and Return.

(Simple Assembly Level Programs)

Interfacing with 8051 based microcontroller system:

Interfacing LEDs, matrix keyboard, LCD & temperature sensors.

Interfacing of Relay, Opto-isolators & Stepper Motors.

Recommended Readings:

1. Morris Mano; Digital Logic & Computer Design; PHI, India.
2. A. Anand Kumar; Fundamentals of Digital Circuits; Second edition, PHI Learning Pvt. Ltd.
3. Kenneth J. Ayala; The 8051 Microcontroller, Architecture, Programming& applications; Second edition; Penram International.
4. Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D McKinlay; The 8051 Microcontroller and embedded Systems Using Assembly and C; Second edition, Pearson
5. Albert P. Malvino and Donald P. Leach; Introduction to Digital Electronics; Tata McGraw Hill.
6. Thomas Floyd; Digital fundamentals; Pearson

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments)

1. Study of Logic Gates
2. Performance of Universal Gates
3. Realization of Boolean expressions in SOP & POS forms.
4. Design of Adders & Subtractors
5. Design of Multiplexers & Demultiplexers
6. Design of Encoders & Decoders
7. Design of Code Converters
8. Performance of Flip-flops
9. Performance of Shift Registers
10. 8051 Microcontroller Programs for arithmetic operations – addition, subtraction, multiplication& division
11. 8051 Microcontroller Programs for block transfer of data
12. 8051 Microcontroller Programs for sorting the numbers
13. 8051 Microcontroller Programs for interfacing with switches & LED's
14. Stepper Motor & servo motor interface (Demonstration)

ME 4.5 APPLIED THERMODYNAMICS – II

Subject Code	Name of the Subject	Scheme of Instruction Hrs/ week			Scheme of Examination						
					Th Duration (Hrs)	Marks					
		L	T	P		Th	S	TW	P	O	Total
ME 4.5	Applied Thermodynamics - II	3	1	2	3	100	25	--	--	--	**125**

Course Objectives:

1. This course aims to provide a good platform to mechanical engineering students to understand, model.
2. To appreciate concept of dynamics involved in thermal energy transformation in power plants.
3. To prepare them to carry out experimental investigation and analysis at later stages of graduation & also concept of availability and quantification of irreversibility.

Course Outcomes:

The student after undergoing this course will be able to:

1. To apply the knowledge of mathematics, science and engineering fundamentals to the solution of mechanical power generation in thermal power plant using pure substance as working substance and low temperature applications.
2. To understand and hence to carryout gravimetric and volumetric analysis in order to find other thermodynamic properties of mixtures.
3. To investigate the effectiveness of energy conversion process in mechanical power generation and low temperature applications with basics of air conditioning.
4. To instill upon to envisage appropriate experiments related to heat engines and refrigeration and air conditioning machines.
5. To appreciate concepts learnt in fundamentals laws of thermodynamics from which learning ideas how to sustain in energy crisis and think beyond curriculum in the field of alternative and renewable sources of energy and refrigerants.
6. To communicate effectively the concepts of internal combustion engines and try to think beyond curriculum in alternative sources of energy.

UNIT - 1 (12 Hours)

Thermodynamic Relations

Maxwell's Equations, Tds equations, Difference and ratios of specific heat capacities, Joule Kelvin effect, Clausius Clayperon equation,

Availability and Irreversibility : Available energy- reversible work & irreversibility- Derivation & calculations for a process and cycle of closed and open systems, Gouy - Stodola Theorem, Second law efficiency, comments on Exergy.

Availability in Chemical reactions.

UNIT - 2 (12 Hours)

Properties of Pure Substance

Definition, P-V-T surface, P-V, P-T diagram, h-s diagram or Mollier chart, Steam tables – Reading and use of various tables & calculations. Measurement of steam quality, Equations of state, Viral expansions, Law of corresponding states, generalized compressibility chart, Other equations of state.

Chemical and phase equilibrium – Criteria for chemical equilibrium, Evaluation of equilibrium constant for Ideal Gas equations, equilibrium between two phases of pure substance, Gibbs phase rule, Metastable equilibrium, chemical equilibrium.

UNIT - 3 (12 Hours)

Modeling Vapour Power & Refrigeration Plants

Basic Rankine cycle with deviation, modified Rankine- reheat, regenerative (ideal & actual) with deviation of cycles, derivation & calculation – efficiency, mean temperature of heat addition, Carnot efficiency and comparative analysis, First law & second law analysis on cycles, Binary vapour cycles and co-generation cycles.

Vapour compression and absorption systems with deviations, Derivation – COP, comparative analysis, first and second law analysis, use of P-h Chart.

UNIT - 4 (12 Hours)

Gaseous Mixtures & Psychrometry

Mixtures of Ideal gases – Dalton's and Amagat's law, Mass and mole fractions, Conversion of gravimetric to volumetric analysis & volumetric to gravimetric analysis, Entropy of mixtures and mixing process, Calculation of internal energy & specific heat of mixtures.

Psychrometry : Dew point temperature, dry bulb temperature, specific humidity, relative humidity, adiabatic saturation, psychrometer, psychromeric chart, basic air conditioning processes – dehumidification & humidification with cooling, basic calculations only

Recommended Readings:

1. Y. A. Cengel, M.A. Boles; Thermodynamics – An Engineering approach; Tata McGraw Hill Education Pvt. Ltd., New Delhi.4th Ed; 2012.
2. P. K. Nag; Engineering Thermodynamics; Tata McGraw Hill Education Pvt. Ltd.; New Delhi.4th Ed.; 2008.
3. G. V. Wylen, R. Sonntag,, C. Borgnakke; Fundamentals of Classic Thermodynamics; John Wiley & Sons, 4th Ed.; 1996.
4. Y. V. C. Rao; Introduction to Thermodynamics; Universities Press Pvt. Ltd.; Hyderabad, 4th Revised Ed.; 2004.
5. M. Moran, H. N. Shapiro; Fundamentals of Engineering Thermodynamics; John Wiley and Sons Inc., 6th Ed.; 2012.
6. E. Radhakrishnan; Fundamentals of Engineering Thermodynamics; Prentice Hall of India Pvt. Ltd., New Delhi, 2nd Ed.; 2011.
7. R. R. Rajput; A text book of Engineering Thermodynamics; Laxmi Publication (P) Ltd., New Delhi, 4th Ed.; 2010.

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments)

1. Analysis of Second law efficiency of Petrol engine.
2. Analysis of Second law efficiency of Diesel engine
3. To find the composition of exhaust of petrol engine (gravimetric/volumetric)
4. To find the composition of exhaust of diesel engine (gravimetric/volumetric)
5. First law analysis on Vapour Compression Refrigeration Machine (VCM)
6. Second law analysis on Vapour Compression Refrigeration Machine (VCM) with second law efficiency
7. First law analysis on Vapour Absorption Refrigeration Machine (VAM)
8. Second law analysis on Vapour Absorption Refrigeration Machine (VAM)
9. First law analysis on steam power plant with second law efficiency
10. Second law analysis on steam power plant with second law efficiency with second law efficiency

ME 4.6 BUSINESS ECONOMICS AND MANAGEMENT

Subject Code	Name of the Subject	Scheme of Instruction Hrs/ week			Scheme of Examination						
					Th Duration (hrs)	Marks					
		L	T	P		Th	S	TW	P	O	Total
ME 4.6	Business Economics and Management	4	--	--	3	100	25	--	--	--	**125**

Course Objectives:

1. To expose students to basic Economic concepts and inculcate an analytical approach to the subject matter.
2. To apply economic reasoning to problems of business.
3. To be able to recognize, formulate and analyze cash flow models in practical situations.
4. To familiarize the students with the basic principles of management.
5. To acquaint the students with standard concepts that they are likely to find useful in their profession when employed.
6. To be able to understand the various concepts in Ethics.

Course Outcomes:

After the successful completion of the course, the student will be able to:

1. Know elements of demand.
2. Understand pricing strategies and economic of pricing discrimination.
3. Understand capital budgeting and working capital management.
4. Appreciate and assimilate ethics and interpersonal behaviour.
5. Understand Safety responsibility and Rights.
6. Understand management concepts such as planning, organising, staffing, leading and control.

UNIT - 1 **(16 Hours)**

Introduction and General Concepts: Demand and Supply- Demand curve, Supply curve, Market Equilibrium

Elasticity of Demand: Individual, firm and market demand and supply, price, income and cross elasticity, applications of elasticity

Estimation/Forecasting of Demand: Meaning, importance, methods – trend, exponential smoothing, regression analysis

National Income Terms: GDP, Real v/s Nominal GDP, Net Domestic Product, GNP, National Income, Per capita income, Disposable Income, Price Index, Inflation.

UNIT - 2 (16 Hours)

Preparation of Income statement, Balance sheet, Fund Flow statement.

Understanding and analyzing them using financial ratios – liquidity, leverage and profitability ratios.

Capital Budgeting: Different Methods of Evaluation of Projects- Payback Period, Discounted Cash Flow methods- Net Present Value, Internal Rate of Return.

Working Capital Management: Determinants of working capital, financing of working capital, dangers of excessive and shortage of working capital.

Break even Analysis.

UNIT- 3 (16 Hours)

General Principles of Management: Introduction to Management, Functions of a manager.

Different schools of management –Scientific , modern operational and behavioural.

Planning : Importance of planning, types of plans.

Controlling: Basic control process, Critical control points and standards, Types of controls.

Requirements for effective controls.

Human Resource Management and Selection, Definition of Staffing, Overview of the staffing function, Selection process, techniques and instruments.

Appraising and Rewarding Performance: Money as a means of Rewarding Employees, performance appraisal, Economic Incentives Systems, the Reward Pyramid

MBO Process, How to set objectives, benefits and weaknesses, Span of management , Factors determining an effective span, Organisation, Structure of organisation, Formal and informal organisation, Departmentation, Matrix Organisation, Strategic Business Unit
Decentralisation and Delegation, OD process.
Leadership: Ingredients of leadership, Theories and Types, Managerial grid.

UNIT- 4 (16 Hours)

Communication: Nature and Importance of Communication, The Two-Way Communication Process, Communication Barriers , Downward and Upward Communication/ Formal Informal Communication, Forms of communication.

Motivation: Model of Motivation, Motivational Drives, Human Needs, Types of Needs, Maslow's Hierarchy of Needs, Hezberg's Two-Factor Theory, Behavior Modification, Goal Setting , Motivational Applications, The Expectancy Model.

Managing Change: Nature of Work Change, three Stage in Change, reaching a New Equilibrium, the Organizational Learning Curve for Change.

Engineering Ethics: Engineering Ethics, Self interest, Customs and Religion.

Interpersonal Behavior: Nature and Levels of Conflict, Sources of Conflict, Effects of Conflict, Model of Conflict: Participant Intentions, Resolution Strategies. Transactional Analysis: Ego States, Types of Transactions, Benefits. Power and Politics, Organizational Politics.

Whistle – Blowing.

Safety Responsibility and Rights: Responsibility of Engineers, Risk-Benefit Analysis, Ethical issues in Cost-benefit Analysis, Ethics and Risk Management, Reducing Risk.

Recommended Readings:

1. Joseph G. Nellis, David Parker; The Essence of Business Economics; Prentice Hall, 1992.
2. A. Alavudeen, R. Kalil Rahman, M. Jayakumaran; Professional Ethics and Human Values; Laxmi Publications.
3. John W. Newstrom, Keith Davis; Organizational Behavior (Human Behavior at Work); Tenth Edition, Tata McGraw Hill.
4. R. L. Varshney, K L Maheswari; Managerial Economics; Nineteenth, Revised and Enlarged Edition; Sultan Chand and Sons Publications.
5. H. Craig Petersen, W. Cris Lewis, Sudhir K. Jain; Managerial Economics; Prentice Hall India.
6. Prasanna Chandra; Fundamentals of Financial Management; Third Edition, Tata McGraw-Hill, New Delhi.
7. Richard M. Lynch, Robert W. Williamson; Accounting for Management, Planning and Control; Third Edition, Tata McGraw-Hill, New Delhi.
8. C. B Gupta; Management: Theory and Practice; Seventeenth Revised and Enlarged edition; Sultan Chand & Sons.
9. P. C. Tripathi, P. N. Reddy; Principles of Management; 2nd edition, Tata McGraw Hill; 1991.