COURSE CURRICULUM AND EVALUATION SCHEME
B. Tech. Mechanical Engineering
(w.e.f. session 2017-18)

G. B. Pant Engineering College, Pauri-Garhwal (Uttarakhand), 246194

1st Year Scheme and Syllabus

COURSES AND EVALUATION SCHEME

YEAR I, SEMESTER I
(B. Tech. Mechanical Engineering)

S. No.	COURSE CODE	SUBJECT	PERIODS			EVALUATION SCHEME				
						SESSIONAL EXAM			ESE	Subject Total
			L	T	P	CT	TA	Total		
A) THEORY										
1.	TEC-111	Basic Electronics Engineering	3	1	0	30	20	50	100	150
2.	TEE-111	Basic Electrical Engineering	3	1	0	30	20	50	100	150
3.	TAH-113	Engineering Mathematics-I	3	1	0	30	20	50	100	150
4.	TAH-114	Engineering Physics	3	1	0	30	20	50	100	150
5.	TAH-115	Professional Communication	3	1	0	30	20	50	100	150
B) PRACTICAL										
6.	PEC-111	Basic Electronics Engineering Lab	0	0	2	10	15	25	25	50
7.	PEE-111	Basic Electrical Engineering Lab	0	0	2	10	15	25	25	50
8.	PAH-114	Engineering Physics Lab	0	0	2	10	15	25	25	50
9.	PCE-111	Engineering Graphics	1	0	2	10	15	25	25	50
10.	GPP-111	General Proficiency (NSS/NCC/Sports/Cultural)	0	0	0	0	50	50	0	50
SEMESTER TOTAL			**16**	**6**	**8**	**190**	**210**	**400**	**600**	**1000**

BASIC ELECTRONICS ENGINEERING

TEC-111

Course Outcomes (CO)		
1	Able to understand the physics, operation and terminal behaviour of basic electronics devices.	CO1
2	Able to design and analyse the basic electronic circuits.	CO2
3	Will be competent enough to understand the applications of electronics devices.	CO3
4	Able to solve engineering problems related to electronics circuits.	CO4
5	Able to understand the digital logic operations and function minimization.	CO5

Unit-I

Semiconductor Materials and Properties: Group-IV materials, Covalent bond, electron-hole concepts, Basic concepts of energy bands in materials, concepts of forbidden gap, Intrinsic and extrinsic semiconductors, donors and acceptors impurities.

Junction Diode: p-n junction, depletion layer, V-I characteristics, diode resistance, capacitance diode ratings (average current, repetitive peak current, non-repetitive current, peak-inverse voltage).

Unit-II

Diode Applications: Rectifiers (half wave and full wave), calculation of transformer utilization factor and diode ratings, filter (C – filter), calculation of ripple factor and load regulation, clipping circuits, clamping circuits, voltage multipliers.

Breakdown Diodes: Breakdown mechanisms (zener and avalanche), breakdown characteristics, zener resistance, zener diode ratings, zener diode application as shunt regulator.

Unit-III

Bipolar Junction Transistors: Basic construction, transistor action, CB, CE and CC configurations, input/output Characteristics, concept of Biasing of transistors- fixed bias, emitter bias, potential divider bias.

Transistor Amplifier: Graphical analysis of CE amplifier, concept of voltage gain, current gain, h-parameter model (low frequency), computation of A_i, A_v, R_i, R_o of single transistor CE and CC amplifier configurations.

Unit-IV

Field Effect Transistors: JFET: Basic construction, transistor action, concept of pinch off, maximum drain saturation current, input and transfer characteristics, characteristics equation CG, CS and CD configurations, Introduction to self and fixed biasing. MOSFFT: depletion and enhancement type MOSFET-construction, operation and characteristics. Computation of A_v, R_i, R_o, of single FET amplifiers using all the three configurations

Unit-V

Switching Theory and Logic Design: Number systems, conversions of bases, Boolean algebra, logic gates, concept of universal gate, and concept of K- Map.

Operational Amplifiers: Concept of ideal operational amplifiers, ideal op-amp parameters, inverting, non- inverting and Unity gain amplifiers, adders.

References:

1. Boylestad and Nashelsky, 'Electronic Devices and circuits' PHI.
2. A Mottershead, 'Electronic Devices and Circuits' PHI.
3. R.K. Singh & Ashish, Basic Electronics Engg. Laxmi Publication.
4. Milman & Halkias, Integrated Electronics, PHI.
5. D.C. Kulshrestha, 'Electronic Devices and Circuits' PHI.

BASIC ELECTRICAL ENGINEERING

TEE-111

Unit-I

Circuit Elements and Network Theorems: Circuit Elements (R, L and C), Active and Passive elements, star – delta transformation, voltage and current sources, source transformation, concept of linearity and linear network, unilateral and bilateral elements Kirchhoff's Law, mesh and nodal analyses (including super-mesh and super-node).

Network Theorems for DC Circuits: Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Maximum Power Transfer Theorem.

Unit-II

AC Fundamentals: Single Phase AC Circuits: Sinusoidal, Square and Triangular waveforms – average and effective (r.m.s.) values, form and peak factors; concept of phasor, phasor representation of sinusoidally varying voltage and current. Analyses of series, parallel, and series – parallel RLC Circuits: Apparent, Active & Reactive Powers, Definition and Importance of Power factor.

Three Phase AC Circuits: Meaning of phase sequence and star and delta connections, balanced supply and balanced load, line and phase voltage/current relations, three phase power and its measurement by using one, two and three watt-meters.

Unit-III

Introduction to Power System: General layout of Electrical Power system and functions of its elements, standard transmission and distribution voltages, and concept of grid.

Measurements and Measuring Instruments: Construction and principle of operation of voltage and current measuring instruments; introduction to power and energy meters.

Unit-IV

Magnetic Circuit and Transformer: Magnetic Circuit: Magnetic circuit concepts, analogy between Electric & Magnetic circuits. B-H curve, Hysteresis and Eddy Current looses.

Single Phase Transformer: Principle of Operation, Construction, e.m.f. equation, equivalent circuit, Losses, efficiency, O.C. and S.C. tests.

Unit-V

Electrical Machines

DC Machines: Types of dc machines, e.m.f. equation of machines and torque equation of motor, characteristics and applications of dc motors.

Three Phase Induction Motor: Principle of Operation, Torque- Slip Characteristics.

Single Phase Induction Motor: Principle of Operation and Methods of starting.

Three Phase Synchronous Machines: Principle of Operation of alternator and synchronous motor.

References:

1. V. Del Toro, "Principles of Electrical Engineering" Prentice Hall International.
2. I. J. Nagarath, "Basic Electrical Engineering" Tata Mc - Graw Hill.
3. D. E. Fitzgerald & A. Grabel Higginbotham, "Basic Electrical Engineering" Mc - Graw Hill
4. Sunil T. Gaikwad, Basic Electrical Engineering, Wiley India.

ENGINEERING MATHEMATICS-I

TAH-113

Course Outcomes (CO)		
1	Able to find the rank of matrix, characteristic equation, characteristic roots and use the applicability of Caley Hamilton theorem to find inverse of matrix which is very important in many engineering applications. Able to know the application of matrices in statics, computer graphics, genetics, chemistry, economics and also in solving electrical and electronics circuits that lead to a system of linear equation.	CO1
2	Able to learn about Leibnitz Theorem, higher order partial derivative, expansion of function of several variable, extreme values for two and three independent variables, Jacobians etc. Every advanced concept in physics requires the use of partial derivatives e.g. Maxwell's equations for electromagnetism, Einstein's equations for general relativity, equation for heat conduction etc.	CO2
3	Able to use of Jacobian in transformation of variables from cartesian to polar, cylindrical and spherical coordinates in multiple integrals. There are numerous practical applications in which it is desired to find the maximum or minimum value of a particular quantity. Such applications exist in economics, business and engineering. Finding maxima or minima has important applications in linear algebra and game theory.	CO3
4	Able to know how to solve double and triple integrals and they can calculate area and volume with the help of it. Learn the evaluation policy of some special function like beta and gamma function and their relation which is helpful to evaluate some definite integral arising in various branch of engineering.	CO4
5	Able to acquire the knowledge of gradient, divergence, curl and the various application of it. Students will also learn about line integral, surface integral, volume integral and two theorems namely Green's theorem and divergence theorem. Students are also able to know the application of vector calculus in differential geometry, study of partial differential equations, study of rigid dynamics, electromagnetism, theory of relativity etc.	CO5

Unit-I

Matrices: Elementary row and column transformation, Rank of matrix, Solution of system of linear equations, Cayley-Hamilton theorem, Eigen values and Eigen Vectors.

Unit-II

Differential Calculus-I: Leibnitz theorem, Partial Differentiation, Euler's theorem, Expansion of function.

Unit-III

Differential Calculus-II: Jacobian, Approximations and errors, Extrema of functions of several variables, Lagrange method of undetermined multipliers.

Unit-IV

Multiple Integrals: Double and triple integrals, Change of order, Change of variables, beta and gamma functions, Drichlet integral and applications.

Unit-V

Vector Calculus: Gradient, divergence and curl of a vector, Line integral and volume integrals, Green theorem and Gauss divergence theorem.

References:

1- Engineering Mathematics, V. N. Kala & R.C.Bhadula, Scientific International Pvt. Ltd New Delhi.
2- Advanced Engineering Mathematics , Kreyszig, Wiley India.
3- A Text book of Engineering Mathematics (Vol.1) by Peter V. O' Neil, Engage Learning.
4- Matrices by V. N. Kala and R Rana , University Press New Delhi.
5- Higher Engineering Mathematics, B.S. Grewal Khanna Publication.

ENGINEERING PHYSICS

TAH-114

Course Outcomes (CO)		
1	Able to apply the knowledge of mathematics and science to develop an understanding of modern physics for the study of mechanical systems.	CO1
2	Able to apply basic knowledge of optics to explain observable phenomena.	CO2
3	Able to analyse and solve introductory engineering problems using polarization & laser and to understand the use of lasers as light sources for low and high energy applications.	CO3
4	Able to articulate the fundamental principles of electrostatics and magnetostatics for different mechanical processes.	CO4
5	Able to understand the superconducting state of materials and to solve engineering problems using the concept of wave and particle nature of radiant energy and to construct a quantum mechanical model to explain the behaviour of a system at microscopic level.	CO5

Unit-I

Interference: Coherent Sources, Conditions of Interference, Fresnel's Biprism Experiment, Displacement of Fringes, Interference in Thin Films – Wedge Shaped Film, Newton's Rings.

Unit-II

Diffraction: Single, Double and n-Slit Diffraction, Diffraction Grating, Raleigh's Criterion of Resolution, Resolving Power of Grating.

Unit-III

Polarization: Phenomenon of Double Refraction, Ordinary and Extra-ordinary Rays, Nicol Prism, Production and Analysis of Plane, Circularly and Elliptically Polarized Light, Fresnel Theory, Optical Activity, Specific Rotation, Polarimeter.

LASER: Principle of Laser Action, Einstein's Coefficients, Construction and Working of He-Ne and Ruby Laser.

Unit-IV

Electromagnetics: Ampere's Law and Displacement Current, Maxwell's Equations in Integral and Differential Forms, Electromagnetic Wave Propagation in Free Space and Conducting Media, Poynting Theorem.

Superconductivity: Essential properties of superconductors, London equations, penetration depth and coherence length , Meissner effect, critical field , critical current Isotope effect, heat capacity, Type I and Type II superconductors, Characteristics of superconductors in superconducting state, applications of superconductors.

Unit-V

Wave Mechanics : Wave Particle Duality, de Broglie Concept of Matter Waves, Wave velocity & Group velocity, Heisenberg Uncertainty Principle, Schrödinger Wave Equation and Its Applications: Particle in a Box.

References:

1. Concepts of Modern Physics, Beiser (Mc-Graw Hill)
2. Introduction to Special theory of Relativity: Robert Resnick - Wiely
3. Optics: Eugene Hecht, (Pearson Education Asia)
4. Laser Fundamentals: W.T. Silfvast. (Cambridge University Press)
5. Introduction to Electrodynamics ,David J. Griffith (PH I)
6. Solid State Physics: C. Kittel (Wiley Eastern)

PROFESSIONAL COMMUNICATION

TAH-115

Course Outcomes (CO)		
1	Able to understand the need and requirement of the global market.	CO1
2	Able to use language as a tool of communication and to improve word power.	CO2
3	Able to enhance the listening skill and reading skills.	CO3
4	Able to enhance speaking skills.	CO4
5	Able to enhance writing skills and to improve the communication skills.	CO5

Unit-I

Communication: Meaning, Definition and importance of communication, Process of communication, types of communication, levels of communication, communication network, language as a tool of communication, barriers to effective communication, technical communication, meaning, origin and development of technical communication, features of technical communication, difference between technical and general writing.

Unit-II

Communicative Skills: Précis writing, Group planning exercise, Picture perception and description, Situation reaction, paragraph development, its techniques and methods.

Unit-III

Business Communication: Principles, features, types, format and layout of business letter, different types of letters- enquiry, quotation, order, sales, complaint, credit etc., job application letter, covering letter, difference between bio-data, resume and CV, notice, agenda, minutes and memorandum.

Unit-IV

Forms of Writing: Technical proposal- meaning, purpose, features, types, format, importance, process of preparation and writing technical proposal; Report- meaning, features, types, style, format, structure and importance; technical paper, project, synopsis, dissertation and thesis writing.

Unit-V

Presentation: Purpose, audience, organizing contents, preparing outline, audio visual aids, body language, voice dynamics, time dimension, Interview (Personal, Telephonic, Interview through video conferencing), Group discussion, Extempore, Listening skills.

References:

1. Technical Communication- Principles and practices by Meenakshi Raman and Sangeeta Sharma, Oxford University Press, New Delhi.
2. Business Correspondence and Report Writing by Prof. R.C. Sharma and Krishna Mohan, Tata McGraw Hill and Co. Ltd., New Delhi.
3. Lucas, Stephen. The Art of Public Speaking, McGraw Hill Companies.
4. Holtz, Shel, Corporate Conversation: A Guide to Crafting Effective and Appropriate Internal Communications, New Delhi: PHI.

BASIC ELECTRONICS ENGINEERING LAB

PEC-111

Course Outcomes (CO)		
1	Able to understand the physics, operation and terminal behaviour of basic electronics devices.	CO1
2	Able to design and analyse the basic electronic circuits.	CO2
3	Will be competent enough to understand the applications of electronics devices.	CO3
4	Able to solve engineering problems related to electronics circuits.	CO4
5	Able to understand the digital logic operations and function minimization.	CO5

1. To determine the energy band gap of a semiconductor material.
2. To determine and plot V-I characteristics of P-N junction in both forward bias and reverse bias.
3. To determine and plot the wave shapes of a clipping and champing circuits.
4. To determine the ripple in output of a half wave and a full wave rectifiers at different loads.
5. To determine and plot V-I characteristics of Zener diode in both forward bias and reverse bias.
6. To determine and input and output characteristics of an npn & pnp bipolar junction transistor in common emitter and common base mode.
7. To determine and plot input and output characteristics of a field-effect transistor.
8. To determine and plot input and output characteristics of a metal-oxide semiconductor field-effect transistor.
9. To determine and plot the frequency response of an amplifier.
10. Realization and verification of the truth table of various logic gates.
11. Realization and verification of the basic logic gates using NAND and NOR gates.

BASIC ELECTRICAL ENGINEERING LAB

PEE-111

1. Verification of KCL and KVL.
2. Verification of Thevenin's and Norton's Theorems.
3. Verification of Maximum power transfer and Superposition theorems.
4. Measurement of power in a three phase circuit by two wattmeter method.
5. Measurement of efficiency of a single phase transformer by load test.
6. Determination of parameters and losses in a single phase transformer by OC and SC test.
7. Load characteristics of DC generator.
8. Speed control of dc shunt motor.
9. Study of running and reversing of a three phase induction motor.
10. Calibration of a single phase energy meter.

**Additional or any other experiment may be added based on contents of syllabi.

ENGINEERING PHYSICS LAB

PAH-114

Course Outcomes (CO)		
1	Able to formulate, analyse and solve a multi-level laboratory problem in electromagnetism.	CO1
2	Able to demonstrate experimental comprehension electric and magnetic systems.	CO2
3	Able to analyse the physical principle involved in the various instruments, also relate the principle to new application.	CO3
4	Able to understand the various experiments in the areas of optics, mechanics and thermal physics will nurture the students in all branches of engineering.	CO4
5	Able to think innovatively and also improve the creative skills that are essential for engineering.	CO5

List of Experiments (At least Ten)

1. To determine the wavelength of monochromatic light by Newton's ring.
2. To determine the wavelength of monochromatic light with the help of Fresnel's biprism.
3. To determine the focal length of two lenses by nodal slide and locate the position of cardinal points.
4. To determine the specific rotation of cane sugar solution using half shade polarimeter.
5. To determine the wavelength of spectral lines using plane transmission grating.
6. To determine the specific resistance of the material of given wire using Carey Foster's bridge.
7. To determine the variation of magnetic field along the axis of a current carrying coil and then to estimate the radius of the coil.
8. To verify Stefan's Law by electrical method.
9. To calibrate the given ammeter and voltmeter.
10. To study the Hall effect and determine Hall coefficient, carrier density and mobility of a given semiconductor material using Hall-effect set up.
11. To determine energy band gap of a given semiconductor material.
12. To determine E.C.E. of copper using Tangent or Helmholtz galvanometer.
13. To draw hysteresis curve of a given sample of ferromagnetic material and from this to determine magnetic susceptibility and permeability of the given specimen.
14. To determine the balistic constant of a ballistic galvanometer.
15. To determine the viscosity of a liquid.

Note: ***Additional experiments may be added based on contents of syllabus.***

ENGINEERING GRAPHICS

PCE-111

A minimum of 08 experiments/sheets from the following:

Unit-I

Introduction: Graphics as a tool to communicate ideas, Lettering and' dimensioning, Construction of geometrical figures like pentagon and hexagon.

Unit-II

Orthographic Projection: Principles of orthographic projections, Principal and auxiliary planes, First and Third angle projections, Projection of points, Pictorial view, Projection of lines parallel to both the planes. Parallel to one and inclined to other, Inclined to both the planes. Application to practical problems, Projection of solid in simple position, Axis or slant edge inclined to one and parallel to other plane, Solids lying on a face or generator on a plane, Sectioning of solids lying in various positions, True shape of the section, Development of lateral surfaces, sheet metal drawing.

Unit-III

Isometric Projection: Principles of isometric projection, Isometric projection using box and offset methods.

References:

1. Bhatt. N.D.: Elementary Engineering Drawing, Charothar Publishing.
2. Laxmi Narayan V & Vaish W. : A Text Book of Practical Geometry on Geometrical drawing.

COURSES AND EVALUATION SCHEME

YEAR I, SEMESTER II

(B. Tech. Mechanical Engineering)

S. No.	COURSE CODE	SUBJECT	PERIODS			EVALUATION SCHEME				
						SESSIONAL EXAM			ESE	Subject Total
			L	T	P	CT	TA	Total		
A) THEORY										
1.	TCS-121	Basic Computer Engineering	3	1	0	30	20	50	100	150
2.	TME-121	Basic Mechanical Engineering	3	1	0	30	20	50	100	150
3.	TAH-121	Engineering Chemistry	3	1	0	30	20	50	100	150
4.	TAH-122	Environmental Science	3	1	0	30	20	50	100	150
5.	TAH-123	Engineering Mathematics-II	3	1	0	30	20	50	100	150
B) PRACTICAL										
6.	PCS-121	Basic Computer Engineering Lab	0	0	2	10	15	25	25	50
7.	PME-121	Basic Mechanical Engineering Lab	0	0	2	10	15	25	25	50
8.	PAH-121	Engineering Chemistry Lab	0	0	2	10	15	25	25	50
9.	PME-122	Workshop Practice	1	0	2	10	15	25	25	50
10.	GPP-121	General Proficiency (NSS/NCC/Sports/Cultural)	0	0	0	0	50	50	0	50
SEMESTER TOTAL			**16**	**4**	**8**	**190**	**210**	**400**	**600**	**1000**

BASIC COMPUTER ENGNEERING

TCS-121

Course Outcomes (CO)		
1	Able to know about the component of computer system, binary codes and different number system.	CO1
2	Able to learn about the concepts of various types of operating system, services and features of operating system.	CO2
3	Able to learn the basic components of internet, computer networks and network topologies	CO3
4	Able to design programming involving decision control structures, loops, functions, pointer and structure.	CO4
5	Able to express the solutions to real world problems clearly and precisely in C language.	CO5

Unit-I

An Introduction of Computer System: Anatomy of a digital Computer, Different Units of Computer System, Classification of Computer Systems, Radix Number systems. Binary codes: BCD, Gray, EBCDIC, ASCII.

Operating System: Operating System Concepts, Operating System services, Types of Operating Systems. Introduction to PC Operating Systems: Unix/Linux, DOS, Windows.

Unit-II

Programming Languages and Algorithms: Machine, Assembly and High Level Language; Assembler, Linker, Loader, Compiler, Interpreter, debuggers, Programming fundamentals: problem definition, algorithms, flowcharts and their symbols.

Unit-III

Computer Networks: Basic concepts of Computer Networks, Working of Internet and its Major features. Network Topologies: Bus, Star, Ring, Hybrid, Tree, Complete, Irregular; Types of Networks: LAN, MAN and WAN.

Electronic Mail: advantages and disadvantages, e-mail addresses, message components, message composition, mailer features, E-mail inner workings, E-mail management, Newsgroups, mailing lists, chat rooms.

Unit-IV

Basics of 'C' Language: C Fundamentals, Basic data types, local and external variables and scope, formatted input/ output, expressions, selection statements, loops and their applications; arrays, functions, recursive functions, pointers and arrays. Strings literals, arrays of strings; applications, Structures, Unions and Enumerations.

Unit-V

Advanced Features of 'C' Language: Preprocessor directives, macro definition, conditional compilation, storage classes, type's qualifiers, Low level programming (Bitwise operators, Bit fields in structures, other low level techniques), error handling, file operations(low level/high level).

References:

1. The C Programming Language by Dennis M Ritchie, Brian W. Kernigham, 1988, PHI.
2. Fundamentals of Computing and C Programming, R. B. Patel, Khanna Publications, 2010, New Delhi.
3. Computer Fundamentals and Programming in C, Reema Theraja, Oxford
4. Information technology, Dennis P. Curtin, Kim Foley, Kunal Sen, Cathleen Morin, 1998, TMH
5. Theory and problem of programming with C, Byron C Gottfried, TMH
6. Using Computers and Information by Jack B. Rochester, 1996, Que Education & Training.

7. C Programming – A modern approach by K.N. King, 1996, WW Norton & Co.

BASIC MECHANICAL ENGINEERING

TME-121

Course Outcomes (CO)		
1	To be able to state the first law and to define heat, work, thermal efficiency and the difference between various forms of energy.	CO1
2	To be able to apply the steady-flow energy equation or the first law of thermodynamics and apply the second law of thermodynamics to thermal cycles.	CO2
3	Basic understanding of the working principle of internal combustion engines and air standard cycles.	CO3
4	Explain the difference in behaviour of ductile and brittle materials and their applications.	CO4
5	Describe the shear stress and bending moment distribution in different types of beams	CO5

Unit-I

Fundamental Concepts and Definitions: Definition of thermodynamics, System, Surrounding and Universe, Phase, Concept of continuum, Macroscopic & microscopic point of view. Thermodynamic equilibrium, Property, State, Path, Process, Cyclic and non cyclic processes, Reversible and irreversible processes, Quasi static process, Energy and its forms, Enthalpy.

Unit-II

Zeroth law, **First law:** First law of thermodynamics. Processes - flow and non-flow, Control volume, Flow work and non-flow work, Steady flow energy equation, **Second law:** Limitations of first law of thermodynamics, Essence of second law, Thermal reservoir, Heat engines. COP of heat pump and refrigerator. Statements of second law and their equivalence, Carnot cycle, Carnot theorem, Clausius inequality, Concept of entropy.

Unit-III

Properties of steam: Properties of steam, Phase transformation process and its graphical representation on p-V, T-V, p-T &T-s diagram, Mollier diagram and Steam Tables, Processes involving steam in closed and open systems.

Introduction to I.C. Engines: Two & four stoke S.I. and C.I. engines, Efficiency and mean effective pressure of Otto cycle, Diesel cycle and Dual cycle.

Unit-IV

Force system and Analysis

Basic concept: Review of laws of motion, transfer of force to parallel position, resultant of planer force system, Free Body Diagrams, Equilibrium.

Friction: Introduction, Laws of Coulomb friction, Equilibrium of bodies involving dry fiction.

Structure Analysis

Beams: Introduction to shear force and bending moment, Shear force and bending moment diagram for statically determinate beams.

Trusses: Introduction, Simple Trusses, Determination of forces in simple truss members, Method of joints and Method of section.

Unit-V

Stress and Strain Analysis

Simple stress and strain: Introduction, Normal shear stresses, Stress-strain diagrams for ductile and brittle materials, Elastic constants, one dimensional loading of members of varying cross section, Strain energy, Thermal stresses.

Compound stress and strains: Introduction, State of plane stress, Principal stress and strain, Mohr's circle for stress.

Pure Bending of Beams: Introduction, Simple bending theory, Stress in beams of different cross sections.
Torsion: Introduction, Torsion of Shafts of circular section, Torque and Twist, Shear stress due to Torque.

References:

1. P. K. Nag, "Engineering Thermodynamics" McGraw Hill.
2. Strength of Materials by Timoshenko and Youngs
3. Singh Onkar, Bhavikatti S.S., Chandra Suresh : Introduction to Mechanical Engineering: Thermodynamics, Mechanics and Strength of Materials, New Age International Publishers
4. Yadav R. : Thermodynamics and Heat Engines, Vol I & II (SI Edition) Central Publishing House Allahabad.
5. Timoshenko, S. And Young D., "Engineering Mechanics" McGraw Hill.
6. Shames, I.H., "Engineering Mechanics", Prentice Hall of India
7. Sadhu Singh, "Mechanics of Solids"

ENGINEERING CHEMISTRY

TAH-121

Course Outcomes (CO)		
1	To bridge the knowledge of chemical science with technical aspect of engineering chemistry.	CO1
2	To give technical knowledge of several industries, where engineering chemistry is used as an integral part like: polymer chemistry, paints, lubricants, fuel, glass etc.	CO2
3	To give knowledge of chemical aspect of water and its treatment.	CO3
4	To give knowledge of different type of corrosions and pollutions and their minimization.	CO4
5	To give brief knowledge of different advance techniques of instrumental chemistry, like: Ultra violet spectroscopy, NMR and Mass spectroscopy.	CO5

Unit-I

General & Organic Chemistry: Molecular orbital diagram of diatomic molecules, valence bond theory & molecular orbital Theory linear combination of atomic orbitals, hybridization, hydrogen bonding, band theory of solids, liquid crystals with their classification applications, Bragg's Law, Fullerenes & their application , organic name reactions (cannizzaro's reaction, aldol condensation, Pinnacol-pinnacolon rearrangement, Beckmann's rearrangement, Hoffmann's rearrangement, Rimmer-Timmer reaction), Optical isomerism & confirmations, E-Z nomenclature, R-S configuration.

Unit-II

Physical & Water Chemistry: Rate of reaction, order & molecularity of reaction, Zero order, First Order, Second order reaction, concept of activation energy, energy barrier, conductance & its variation with dilution, corrosion, its type, Mechanism & control , Theory of Electrochemical corrosion. Hardness of water, boiler feed water, softening of water (Calgon Process, Zeolite process, Lime Soda process & Ion exchange process Reverse osmosis), treatment of boiler feed water.

Unit-III

Chemistry of Engineering Materials: Introduction & classification of polymers, Types of Polymerization, , copolymers, vulcanization , PVC, Polyamides, Polyurethane, Polyethylene, Poly propylene, PET, Resins (Phenol Formaldehyde), PMMA, PAN, Rubber, Conducting and Biodegradable polymers, Toughened glass, Strengthening of glass.

Unit-IV

Fuels & Combustion and Environmental Pollution: Classification of Fuels, calorific value of fuel, gross & net calorific value, determination of calorific value using Bomb calorimeter, Coal, Biomass and Biogas, Bio Fuel, Introduction of Lubricants, Mechanism of Lubrication, Classification of Lubricant, Bio Lubricant, Flash and Fire Point, Pour Point, Cloud Point, Aniline point, Viscosity index. Environmental pollution: Types of pollution & pollutants, Air Pollution. Formation and depletion of ozone, smog and Acid rain, Toxic chemicals in Environment: Basic concepts, Brief idea about the environmental impact of toxic chemicals specially, CO, NxOx, SOx, O_3, Pesticides, environmental management.

Unit-V

Analytical Methods and Applications: Titrimetric analysis with reference to acid-base, redox, precipitation and complexometric titrations. Elementary ideas and simple applications of UV, visible, mass and HNMR spectral techniques.

References:

1. Text book of Engineering Chemistry by R.N. Goyal and Harmendra Goel, Ane publication Delhi
2. Engineering Chemistry by R.P. Mani & K.N. Mishra, Cengage learning India Pvt. Ltd. Delhi
3. Engineering Chemistry by Shashi Chawla, Dhanpat Rai & Co., New Delhi.

4. Physical Chemistry by Atkin's, Oxford University Press.
5. Organic Chemistry by Morrisson & Boyd, Pearson Publication.
6. Organic Chemistry by Loudon, Oxford University Press.
7. Concise Inorganic Chemistry by J.D. Lee, Wiley – India.
8. Chemistry concepts and applications by Steven S.Zumdahl from Cengage Learning India Pvt. Ltd., New Delhi.

ENVIRONMENTAL SCIENCE

TAH-122

Unit-I

Natural Resources: Renewable and Non-renewable Resources: Natural resources and associated problems.

Forest Resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people.

Water Resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.

Mineral Resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

Food Resources: World food problems, changes caused by agriculture and over-grazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.

Energy Resources: Growing energy needs renewable and non renewable energy sources use of alternate energy sources, case studies.

Land Resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification, role of an individual in conservation of natural resources, equitable use of resources for sustainable lifestyles.

Unit-II

Ecosystems: Concept of an ecosystem, structure and function of an ecosystem, producers, consumers and decomposers, energy flow in the ecosystem, ecological succession, food chains, food webs and ecological pyramids, introduction, types, characteristic features, structure and function of the Forest ecosystem; Grassland ecosystem; Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

Unit-III

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

Unit-IV

Environmental Pollution & Social Issues: Definition, cause, effects and control measures of air pollution, water pollution, soil pollution, marine pollution, noise pollution, thermal pollution, nuclear hazards, disaster management: floods, earthquake, cyclone and landslides, from unsustainable to sustainable development, urban problems related to energy, water conservation, rain water harvesting, watershed management, environmental ethics: issues and possible solutions, climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies, wasteland reclamation, consumerism and waste products.

References:

1. M Ajni Reddy, Text book of environmental Science, BS Publication, Hyderabad
2. Environmental Studies by Daniel, Wiley India
3. Environmental Studies by Erach Bharucha, University Press.
4. Fundamental of Ecology, E.P.Odum, Cengage Learning.

ENGINEERING MATHEMATICS-II

TAH-123

Course Outcomes (CO)		
1	Students will able to apply differential equations in many real-life problems like solving electrical circuits, mathematical modelling, chemical reactions, Newton's law of cooling etc. They will also learn to visualise and manipulate ODEs in graphical, numerical and symbolic form.	CO1
2	Students will be familiar with Laplace transform and its application in electrical engineering, control engineering and signal processing and also able to solve simple linear and simultaneous linear differential equations by Laplace transform method.	CO2
3	Students will be able to learn about infinite series and also able to know the fundamental concepts of different tests like Leibnitz test, Integral tests, Comparison of ratio's, D'Alembert ratio tests, Raabe's test and Cauchy root test.	CO3
4	Students will be able to use Fourier series in electrical engineering, vibration analysis, signal processing, image processing etc. They will also know how to solve linear partial differential equations with constant coefficients of second order.	CO4
5	Students will be able to solve one dimensional wave equation, Laplace equation in two dimensions, heat conduction equations of one dimension and two dimensions by the method of separation of variables.	CO5

Unit-I

Differential Equations: Ordinary differential equations of first order, Exact differential equations, Linear differential equations of first order, Linear differential equations of nth order with constant coefficients, Complementary functions and particular integrals, Simultaneous linear differential equations.

Unit-II

Laplace Transform: Laplace transform, Laplace transform of derivatives, Inverse Laplace transform, Laplace transform of periodic function, Convolution theorem, Applications to solve simple linear and simultaneous liner differential equations.

Unit-III

Infinite Series: Sequences, Series, Convergence, Series of positive terms, Comparison tests, Integral tests, Raabe's test, Cauchy root test, Ratio test.

Unit-IV

Fourier Series and Partial Differential Equations: Periodic functions, Trigonometric series, Fourier series of periodic function, Euler's formula, Even and odd functions, Half range sine and cosine series. Introduction to partial differential equations, Linear partial differential equations with constant coefficients of second order.

Unit-V

Applications of Partial Differential equations: Method of separation of variables for solving partial differential equations, One dimensional wave equation, Laplace equation in two dimensions, Heat conduction equations of one dimension and two dimension.

References:

1. Engineering Mathematice, Sem,.II Dr. V N. Kala & R.C. Bhadula, Scientific International Pvt Ltd New Delhi.
2. B. S. Grewal: Higher Engineering Mathematics, Khanna Publications .
3. E. Kreyszij: Advanced Engineering Mathematics, Wiley Eastern.

4. A Text book of Engineering Mathematics (Vol.2) by Peter V. O' Neil, Cengage Learning.
5. M.D. Raisinghania: Ordinary & Partial Differential Equations, S. Chand Publication.

BASIC COMPUTER ENGINEERING LAB

PCS-121

Course Outcomes (CO)		
1	Learn the basic of C programming with emphasis on solving real world problems.	CO1
2	Apply procedure-oriented approach and compile and debug programming solving problems.	CO2
3	Design programs involving decision control structures, loops and functions.	CO3
4	Use different data structures and create/update basic data files, network and network devices.	CO4
5	Optimize or re-engineered already existing solutions to various problems.	CO5

1. Write a program to find the largest of three numbers. (if-then-else)
2. Write a program to find the largest number out of ten numbers (for-statement)
3. Write a program to find the average mail height & average female heights in the class (input is in form of sex code, height).
4. Write a program to find roots of quadratic equation using functions and switch statements.
5. Write a program using arrays to find the largest and second largest no. out of given 50 nos.
6. Write a program to multiply two matrices.
7. Write a program to sort numbers using Sorting Algorithm.
8. Represent a deck of playing cards using arrays.
9. Write a program to check that the input string is a palindrome or not.
10. Write a program to read a string and write it in reverse order.
11. Write a program to concatenate two strings.
12. Write a program which manipulates structures (write, read, and update records).
13. Write a program which creates a file and writes into it supplied input.
14. Write a program which manipulates structures into files (write, read, and update records).

BASIC MECHANICAL ENGINEERING LAB

PME 121

Course Outcomes (CO)		
1	To familiarize students with the basic principles of working of IC engines and energy conversion units (vapor compression refrigeration and air conditioning unit).	CO1
2	To understand the concept of engineering measurements (moment of inertia and coefficient of friction) involved in basic engineering mechanics.	CO2
3	To understand the experimental techniques applied in engineering mechanics and material testing (impact testing, Vickers's hardness testing and tensile testing)	CO3
4	To analyse, organize and present experimental results.	CO4
5	To enhance student's abilities of understanding of basic concepts of functioning of mechanical components and enable to deal multidisciplinary problems as a team unit.	CO5

A minimum of 08 experiments from the following:

1. Study of Steam engine and steam turbine models.
2. Study of 2-stroke and 4 -stroke I.C.E. models.
3. Study of Fiat engine and/ or Diesel engine prototype.
4. Study of a vapour compression Refrigeration Unit tutor/refrigerator.
5. Study of a window type air conditioner.
6. To conduct the tensile test on a UTM and determine ultimate Tensile strength, percentage elongation for a steel specimen.
7. To conduct the compression test and determine the ultimate compressive strength for a specimen.
8. To conduct the Impact test (Izod / Charpy) on the Impact testing machine and to find the impact strength.
9. To determine the value of acceleration due to gravity by Atwood's Machine apparatus.
10. To verify the principle of moment by Bell Crank Lever Apparatus
11. To determine the moment of inertia of a flywheel apparatus about its axis of rotation
12. To verify Newton's second law o f motion by Fletcher's Trolley apparatus
13. To find out coefficient of friction by combined inclined plane & friction slide apparatus
14. To determine the velocity ratio, mechanical advantage & efficiency of a single purchase crab apparatus & draw graph between load vs effort, mechanical advantage and efficiency.
15. To determine the velocity ratio, mechanical advantage & efficiency of a double purchase crab apparatus.

* *Additional or any other experiment may be added based on contents of syllabi.

ENGINEERING CHEMISTRY LAB

PAH-121

Course Outcomes (CO)		
1	To give knowledge of different analytical technique of chemistry.	CO1
2	To give an idea about volumetric and gravimetric methods of analysis.	CO2
3	To give knowledge about several volumetric methods used in several industries like water, hospitals, dying, metallurgies etc.	CO3
4	To give an idea about some of the old and latest instrumental aspects of analysis like U.V. spectroscopy methods, viscometric methods, pH metric analysis.	CO4
5	To give an idea about some useful techniques of industries like chromatography, bomb calorimeter, coal analysis.	CO5

List of Experiments (Any Ten)

1. To determine the percentage of available chlorine in the supplied sample of Bleaching powder.
2. To determined the Ferrous content in the supplied sample of iron ore by titrimetric analysis against standard $K_2Cr_2O_7$ solution using $K_3Fe(CN)_6$ as external indicator.
3. To determine the chlorine content in the supplied water sample using Mohr's method.
4. To determine the constituents and amount of alkalinity of the supplied water sample.
5. To determine the Temporary and Permanent hardness of water sample by Complexometry.
6. To determine the iron concentration in the sample of water by Spectro- Photometric method.
7. To determine the Molecular weight of a Polystyrene sample by using Viscometric Method.
8. To determine the pH of a solution using a pH meter and titration of such a solution pH-metrically.
9. To determine the calorific value of a fuel sample by using a Bomb Calorimeter.
10. Determination of Rf factor using Paper Chromatography.
11. Determination of Eq. Wt. of Iron using chemical displacement method.
12. Analysis of a coal sample by proximate analysis method.
13. Determination of flash & fire point of lubricating oil.
14. Determination of heat of neutralization of Hydrochloric acid & Sodium hydroxide.

WORKSHOP PRACTICE

PME 122

Course Outcomes (CO)		
1	To enable students to make use of various machine particularly lathe machine in machine shop.	CO1
2	To enable students to practice arc welding and have basic knowledge of gas welding.	CO2
3	To enable students to learn process and application of foundry process.	CO3
4	To make students familiar with wood working in carpentry shop.	CO4
5	To enable students to learn operations of various tools and equipment's in fitting shop.	CO5

A minimum of 08 experiments from the following (at least two from each):

1. Carpentry Shop:
1. Study of tools and operation and carpentry joints.
2. Simple exercise using jack plain.
3. To prepare half- lap corner joint, mortise and tennon joints.
4. Simple exercise on woodworking lathe.

2. Fitting Bench Working Shop:
1. Study of tools and operations
2. Simple exercises involving filling work.
3. Making perfect male-female joint
4. Simple exercise involving drilling/tapping/dieing.

3. Black Smithy Shop:
1. Study of tools and operations
2. Simple exercises based on black smithy operations such as upsetting, drawing down, punching, bending, fullering & swaging.

4. Welding Shop:
1. Study of tools and operations.
2. Simple butt joint.
3. Lap joint.
4. Oxy acetylene welding.

5. Sheet metal shop:
1. Study of tools and operations.
2. Making funnel complete with soldering.
3. Fabrication of tool box, tray, electrical panel box etc

6. Machine Shop:
1. Study of tools and operations.
2. Plane turning.
3. Step turning.
4. Taper turning
5. Threading.
6. Single point cutting tool grinding.

References:
1. Hajra, Bose, Roy: Workshop Technology Vol 1 & 2, Media Promotors
2. Raghuvanshi B.S.: Workshop Technology, Vol 1 & 2, Dhanpatrai

2nd Year Scheme and Syllabus

COURSES AND EVALUATION SCHEME

YEAR II, SEMESTER III

(B. Tech. Mechanical Engineering)

S. No.	COURSE CODE	SUBJECT	PERIODS			EVALUATION SCHEME				
						SESSIONAL EXAM			ESE	Subject Total
			L	T	P	CT	TA	Total		
A) THEORY										
1.	TME-231	Fluid Mechanics	3	1	0	30	20	50	100	150
2.	TME-232	Material Science	3	1	0	30	20	50	100	150
3.	TME-233	Solid Mechanics	3	1	0	30	20	50	100	150
4.	TME-234	Engineering Thermodynamics	3	1	0	30	20	50	100	150
5.	TME-235	Industrial Engineering & Management	3	1	0	30	20	50	100	150
B) PRACTICAL										
6.	PME-231	Fluid Mechanics Lab	0	0	2	10	15	25	25	50
7.	PME-232	Material Science Lab	0	0	2	10	15	25	25	50
8.	PME-233	Material testing Lab	0	0	2	10	15	25	25	50
9.	PME-236	Machine Drawing Lab	1	0	2	10	15	25	25	50
10.	GPP-231	General Proficiency (NSS/NCC/Sports/Cultural)	-	-	-	-	50	50	-	50
SEMESTER TOTAL			**15**	**5**	**8**	**190**	**210**	**400**	**600**	**1000**

FLUID MECHANICS

TME-231

Course Outcomes (CO)		
1	Knowledge of basic principle of fluid mechanics.	CO1
2	Ability to analyse fluid flow problems with the application of the momentum and energy equation.	CO2
3	Capability to analyse pipe flows as well as fluid machinery.	CO3
4	Explain and demonstrate about the open channel flow.	CO4
5	Ability to analyse boundary layer thickness for external flows.	CO5

Unit-I

Introduction: Fluid and continuum, Physical properties of fluids, Rheology of fluids.

Kinematics of Fluid flow: Types of fluid flows: Continuum & free molecular flows. Steady and unsteady, uniform and non-uniform, laminar and turbulent flows, rotational and irrotational flows, compressible and incompressible flows, subsonic, sonic and supersonic flows, subcritical, critical and supercritical flows, one, two and three dimensional flows, streamlines, continuity equation for 1-D and 3-D flows, circulation, stream function and velocity potential, source, sink, doublet and half-body.

Unit-II

Fluid Statics: Pressure-density-height relationship, manometers, pressure transducers, pressure on plane and curved surfaces, centre of pressure, buoyancy, stability of immersed and floating bodies, fluid masses subjected to linear acceleration and uniform rotation about an axis.

Dynamics of Fluid Flow: Euler's equation of motion along a streamline and its integration, Bernoulli's equation and its applications- Pitot tube, orifice meter, venturi meter and bend meter, Hot-wire anemometer and LDA, notches and weirs, momentum equation and its application to pipe bends.

Unit-III

Dimensional Analysis and Hydraulic Similitude: Dimensional analysis, Buckingham's Pi theorem, important dimensionless numbers and their significance, geometric, kinematics and dynamic similarity, model studies.

Unit-IV

Laminar and Turbulent Flow: Equation of motion for laminar flow through pipes, Stokes law, transition from laminar to turbulent flow, turbulent flow, types of turbulent flow, isotropic, homogenous turbulence, scale and intensity of turbulence, measurement of turbulence, eddy viscosity, mixing length concept and velocity distribution in turbulent flow over smooth and rough surfaces, resistance to flow, minor losses, pipe in series and parallel, power transmission through a pipe, siphon, water hammer, three reservoir problems and networks.

Unit-V

Boundary Layer Analysis: Boundary layer thickness, boundary layer over a flat plate, laminar boundary layer, application of momentum equation, turbulent boundary layer, laminar sub layer, separation and its control, Drag and lift, drag on a sphere, a two dimensional cylinder, and an aerofoil, Magnus effect.

References:

1. Fox, Introduction to Fluid Mechanics, 7ed, Wiley India
2. Zoeb Hussain, Basic Fluid Mechanics & Hydraulic Machines, B S Publications
3. S Narasimhan: First Course in Fluid Mechanics, University Press
4. Som, S.K. & Biswas G.: Introduction of fluid mechanics & Fluid Machines, TMH, 2000, 2nd edition.
5. M M Das: Fluid Mechanics & Turbomachines, Oxford University Press
6. Vijay Gupta and S.K.Gupta, " Fluid Mechanics and its Applications", Wiley Eastern Ltd, 1984.

MATERIAL SCIENCE

TME-232

Course Outcomes (CO)		
1	Analyse the Structure of materials at different levels, basic concepts of crystalline materials like unit cell, FCC, BCC, HCP, APF (Atomic Packing Factor), Co-ordination Number etc.	CO1
2	Understand concept of mechanical behaviour of materials and calculations of same using appropriate equations.	CO2
3	Explain the concept of phase & phase diagram & understand the basic terminologies associated with metallurgy. Construction and identification of phase diagrams and reactions.	CO3
4	Understand and suggest the heat treatment process & types. Significance of properties Vs microstructure. Surface hardening & its types. Introduce the concept of hardenability & demonstrate the test used to find hardenability of steels.	CO4
5	Explain features, classification, applications of newer class materials like smart materials, piezoelectric materials, biomaterials, composite materials etc.	CO5

Unit-I

Introduction: Historical perspective, importance of materials, Brief review of modern & atomic concepts in Physics and Chemistry. Atomic models, Periodic table, Chemical bonding.

Crystallography and Imperfections: Concept of Unit cell space lattice, Bravais lattices, common crystal structures, Atomic packing factor and density, Miller indices, X-ray crystallography techniques, Imperfections, Defects & Dislocations in solids.

Unit-II

Mechanical properties and Testing: Stress strain diagram, Ductile & brittle material, Stress vs. Strength, Toughness, Hardness, Fracture, Fatigue and Creep. Testings such as Strength tastings, Hardness testing, Impact tastings, Fatigue testing Creep testing, Non-destructive testing (NDT)

Micro structural Exam: Microscope principle and methods, Preparation of samples and Microstructure exam and grain size determination, Comparative study of microstructure of various metals & alloys such as Mild steel, CI, Brass.

Phase Diagram and Equilibrium Diagram: Unary and Binary diagrams, Phase rules. Types of equilibrium diagrams: Solid solution type, eutectic type and combination type, Iron-carbon equilibrium diagram.

Unit-III

Ferrous materials: Brief introduction of iron and steel making furnaces, various types of carbon steels, alloy steels and cast irons, its properties and uses.

Heat Treatment: Various types of heat treatment such as Annealing, Normalizing, Quenching, Tempering and Case hardening. Time Temperature Transformation (TTT) diagrams.

Non-Ferrous metals and alloys: Non-ferrous metals such as Cu, Al, Zn, Cr, Ni etc. and its applications. Various type Brass, Bronze, bearing materials, its properties and uses. Aluminium alloys such as Duralumin. Other advanced materials/alloys.

Unit-IV

Magnetic properties: Concept of magnetism - Dia, para, Ferro Hysteresis. Soft and hard magnetic materials, Magnetic storages.

Electric properties: Energy band concept of conductor, insulator and semi-conductor, Intrinsic & extrinsic semi-conductors. p-n junction and transistors. Basic devices and its application, Diffusion of Solid. Super conductivity and its applications, Messier effect, Type I & II superconductors, High Tc superconductors.

Unit-V

Ceramics: Structure types and properties and applications of ceramics, Mechanical/Electrical behaviour and processing of Ceramics.

Plastics: Various types of polymers/plastics and its applications, Mechanical behaviour and processing of plastics, Future of plastics.

Other materials: Brief description of other material such as optical and thermal materials concrete, Composite Materials and its uses, Brief introduction to Smart materials & Nano-materials and their potential applications.

Performance of materials in service: Brief theoretical consideration of Fracture, Fatigue, and Corrosion and its control.

References:

1.Callister/Balasubramaniam – Callister‟s Material Science & Engineering Wiley India
2. Van Vlack - Elements of Material Science & Engineering John Wiley & Sons.
3. V. Raghvan - Material Science, Prentice Hall.
4. Chawla, Composite Materials, T & F

SOLID MECHANICS

TME- 233

Course Outcomes (CO)		
1	Ability to understand the fundamental concept of stress and strain in mechanics of solid and structures.	CO1
2	The ability to analyse determinate beams and trusses to determine shear forces, bending moments and axial forces.	CO2
3	A sufficient knowledge in designing shafts to transmit required power and also spring for its maximum energy storage capacities.	CO3
4	Identify modes of failure in components	CO4
5	An ability to identify, formulate and solve engineering problems.	CO5

Unit-I

Compound stress and strains: Introduction, review of simple stress and strain, state of plane stress, Principal stress and strain. Mohr's stress Circle, 3-D Stress, Theory of failure, Castiglion's Theorem, Impact load: Three-dimensional state of stress & strain, equilibrium equations. Generalized Hook's Law.

Unit-II

Stresses in Beams: Review of pure Bending, Shear Force and Bending moment diagram for statically indeterminate beam, Direct and shear stresses in beams due to transverse and axial loads, composite beams. Deflection of Beams: Equation of elastic curve, cantilever and simply supported beams, Macaulay's method, area moment method, fixed and continuous beams. Torsion: Review of Torsion, combined bending & torsion of solid & hollow shafts.

Unit-III

Helical and Leaf Springs: deflection of springs by energy method, helical springs under axial load and under axial twist (respectively for circular and square cross sections) axial load and twisting moment acting simultaneously both for open and closed coiled springs, laminated springs.

Columns and Struts: Combined bending and direct stress, middle third and middle quarter rules. Struts with different end conditions. Euler's theory and experimental results, Rankine Jordan Formulae, Examples of columns in mechanical equipments and machines.

Unit-IV

Thin cylinders & spheres: Hoop and axial stresses and strain. Volumetric strain. Thick cylinders: Radial, axial and circumferential stresses in thick cylinders subjected to internal or external pressures, Compound cylinders. Stresses in rotating shaft and cylinders. Stresses due to interference-fit.

Unit-V

Curved Beams: Bending of beams with large initial curvature, position of neutral axis for rectangular, trapezoidal and circular cross sections, stress in crane hooks, stress in circular rings subjected to tension or compression

Unsymmetrical Bending: Properties of beam cross-section slope of neutral axis, stress and deflection in unsymmetrical bending, determination of shear center and flexural axis (for symmetry about both axis and about one axis) for I-section and channel section.

References:

1. S. C. Crandall, N. C. Dahl, and T. J. Lardner, An Introduction to the Mechanics of Solids, 2e, McGraw Hill, 1978.
2. Fundamentals of Strength of Materials, Nag, Wiley India
3. E. P. Popov, Engineering Mechanics of Solids, Prentice Hall, 1990
4. Mechanics of Materials by Bear Jhonson
5. Advanced Mechanics of Materials, 6ed, Boresi, Wiley
6. Strength of Materials by Ryder

7. Strength of Materials by Timoshenko and Youngs
8. L. S. Srinath, “Mechanics of Materials”

ENGINEERING THERMODYNAMICS

TME-234

Course Outcomes (CO)		
1	Ability to apply fundamental concepts of thermodynamics to engineering applications.	CO1
2	Knowledge and understanding of the theory behind the various thermodynamics process and cycles.	CO2
3	Ability to apply thermodynamic analysis to a system or control volume	CO3
4	Ability to estimate the thermodynamic properties of the pure substance.	CO4
5	Ability to identify the properties of substances on property diagrams and obtain the data from property tables. Capability to determine thermodynamic efficiency of various energy related processes	CO5

Unit-I

Introduction: Work and Heat transfer, First Law of Thermodynamics, PMM1, First Law Applied to a Process: steady flow energy equation (SFEE) and its application , Second Law of Thermodynamics: Kelvin Plank and Clausius statement and their equivalence, PMM2, Carnot theorem and corollaries of Carnot theorem, Entropy: Clausius inequality, entropy generation, principle of increase of entropy, Properties of Pure Substance

Unit-II

Available Energy, Exergy and Irreversibility: Available energy, available energy referred to a cycle, quality of energy, maximum work in a reversible process, reversible work by an open system exchanging heat only with surroundings, useful work, dead state, availability, availability in a chemical reaction, irreversibility and Gouy- Stodala Theorem, availability or exergy balance, second law efficiency, comments on exergy, Helmholtz and Gibb's function.

Unit-III

Thermodynamic Relations, Equilibrium and Third Law: Mathematical conditions for exact differential, Maxwell's equation, T-ds equations, difference in heat capacities, ratio of heat capacities, energy equation, Clausius-Clapeyron equation, evaluation of thermodynamic properties from an equation of state, general thermodynamic considerations on an equation of state, mixtures of variable composition, conditions of equilibrium of a heterogeneous system, Gibbs phase rule, types of equilibrium, local equilibrium conditions, conditions of stability, Joule-Kelvin effect, Joule-Thompson coefficient and Inversion curve, coefficient of volume expansion, adiabatic and isothermal compressibility.

Unit-IV

Power Cycles

Vapour power cycles: Rankine Cycle, Actual Vapour Cycle Processes, Comparison between Rankine and Carnot Cycles, Mean Temperature of Heat Addition, Reheat cycle, regenerative cycle.

Gas power cycles: Carnot cycle, Stirling cycle, Ericsson cycle, Air standard cycles, Otto cycle, Diesel cycle, Limited pressure cycle or Dual cycle, comparison of Otto, Diesel and Dual cycles, Atkinson Cycle, Brayton cycle, Aircraft propulsion, Brayton-Rankine combined cycle.

Unit-V

Gas compressors: Compression processes, work of compression, single stage reciprocating air compressor, volumetric efficiency, multi stage compression, air motors, rotary compressors, blowers and fans.

References:

1. Engineering Thermodynamics by Jones and Dugans, PHI Learning Pvt. Ltd.
2. Fundamentals of Thermodynamics by Sonntag, Wiley India
3. Fundamentals of Classical Thermodynamics by Van Wylen, John Wiley and Sons.
4. Gas Turbine Theory & Practice, by Cohen & Rogers, Addison Weslay Longman Ltd.

INDUSTRIAL ENGINEERING AND MANAGEMENT

TME -235

Course Outcomes (CO)		
1	Ability to analyse the Productivity and various methods of improving Productivity.	CO1
2	Ability to understand the layout of industries.	CO2
3	Capability to analyse Economic Order Quantity.	CO3
4	Knowledge of basic principal of maintenance.	CO4
5	Ability to analyse Quality control and understand the industrial organization structure.	CO5

Unit-I

Productivity: Introduction, definition, measurement, productivity index, ways to improve productivity, Types of Production System.

Work study: Meaning and benefits of work study, time & motion study. Micro motion study P.M.T.S. man machine Diagram flow chart. Motion economy, Method study, work measurement, Work sampling, standard time.

Unit-II

Plant layout and materials Handling: Plant location, type of layout, principles of facility layout principles of material handling, Material Handling equipments.

Replacement Analysis: Depreciation causes, obsolescence, service life of assets, Replacement of items.

Maintenance Management: Maintenance Planning & Control, Maintenance Strategy

Unit-III

Inventory Control: Inventory, function, cost, deterministic models, Introduction to MRP, supply chain Management

Break Even Analysis: Introduction, Assumption in Break-Even analysis, Effect of increase or decrease in Fixed cost and Variable cost on BEF.

Unit-IV

MRP: Concept of MRP, Inputs to MRP, MRP processing, MRP outputs, Benefits and Limitations of MRP, Introduction to MRP-II.

Job Analysis and Merit Rating: Objectives of Job evaluation, Principles of Job evaluation, Method Job evaluation, Merit Rating, Selection of factors in setting up Rating Method.

Unit-V

Introduction to Management: Theories of management: Traditional behavioral, contingency and systems approach, Organization as a system, Design of organization structure, leadership styles and managerial grid, Japanese management techniques, Case studies.

References:

1. Principles of management. An analysis of management functions-H. Koontz & C.O. Donnel. Tata Mc-Graw-Hall Co.
2. Motion and Time Study Design and Measurement of Work, 7ed, Barnes, Wiley India
3. Manufacturing Management-J Moore Prentice Hall Englewood Cliffs: New Jersey.
4. Modern production operations Management-Buffa, E.S. Wiley Eastern.
5. Industrial Engineering & Management O.P. Khanna.
6. Industrial Engineering by Ravi Shanker.
7. Industrial Engineering by Mahajan.
8. Schermerhorn,; Management and Organisational Behaviour essentials, Wiley India
9. Koontz: Essentials of Management, PHI Learning.

FLUID MECHANICS LAB

PME-231

Course Outcomes (CO)		
1	To work on Fluid Mechanics equipment's and to apply the knowledge of fluid mechanics to perform experiments.	CO1
2	To understand the concepts of engineering measurements involved in fluid mechanics.	CO2
3	To understand experimental techniques in the fluid flow analysis.	CO3
4	To organize and conduct an experimental investigation.	CO4
5	To analyse and present experimental results	CO5

A minimum of 08 experiments from the following:

1. To verify the momentum equation using the experimental set-up on diffusion of submerged air jet.
2. To determine the coefficient of discharge of an orifice of a given shape and also determine the coefficient of velocity and the coefficient of contraction of the orifice mouth piece.
3. To calibrate an orifice meter, venturimeter, and bend meter and study the variation of the coefficient of discharge with the Reynolds number.
4. To study the transition from laminar to turbulent flow and to determine the lower critical Reynolds number.(Using helishaw and reynolds appratus)
5. To study the velocity distribution in a pipe and also to compute the discharge by integrating the velocity profile.
6. To study the variation of friction factor (f) for turbulent flow in commercial pipes.
7. To study the boundary layer velocity profile over a flat plate and to determine the boundary layer thickness.
8. To find out metacentric height of a given ship model.
9. To verify the bernaulli's equation expermentaly.
10. To calibrate and find the performance of notches.
11. To determined the head losses in different pipe fittings.

* *Additional or any other experiment may be added based on contents of syllabi.

MATERIAL SCIENCE LAB

PME- 232

Course Outcomes (CO)		
1	Able to produce the mold for the small metallic specimen.	CO1
2	Able to prepare the sample for microstructure observations.	CO2
3	Able to explain the microstructure and correlate their mechanical properties with the microstructure.	CO3
4	Able to explain the microstructure and correlate their mechanical properties with the microstructure of different materials.	CO4
5	Able to explain the effect of heat treatments on the microstructures of different materials and on the mechanical properties.	CO5

A minimum of 08 experiments from the following:

1. Making a plastic mould for small metallic specimen.
2. Specimen preparation for micro structural examination-cutting, grinding, polishing, etching.
3. Grain size determination of a given specimen.
4. Comparative study of microstructures of different given specimens (mild steel, gray cast iron, brass, copper etc.)
5. Heat treatment experiments such as annealing, normalizing, quenching, case hardening and comparison of hardness before and after.
6. Material identification of, say, 50 common items kept in a box.
7. Faradays law of electrolysis experiment.
8. Study of corrosion and its effects.
9. Study of microstructure of welded component and HAZ, Macro and Micro Examination.
10. Suitable experiment on Magnetic/ Electrical/ Electronic materials.

* *Additional or any other experiment may be added based on contents of syllabi.

MATERIAL TESTING LAB

PME- 233

Course Outcomes (CO)		
1	The students are able to perform the test and able to find out the toughness of the materials.	CO1
2	The students are able to perform the test and able to find out the Hardness of the materials.	CO2
3	The students are able to perform the mentioned test and able to find out the strength of the materials.	CO3
4	The students are able to perform the Fatigue Test and able to find out the Fatigue strength of the materials.	CO4
5	The students are able to perform Dye Penetration Test to identify the cracks within the Weld in a butt joint.	CO5

A minimum of 08 experiments from the following:

1. To perform Tensile Test on Mild-steel specimen and draw stress strain curve.

2. To perform Izod, Charpy Impact test on standard specimen.

3. To perform Brinell, Rockwell, Vicker Hardness Test on standard specimen.

4. To calculate spring stiffness.

5. To calculate Torsional Rigidity.

6. To calculate Fatigue Test on Fatigue Testing Machine

7. To calculate Modulus of Elasticity by Non Destructive Testing.

8. Detection of cracks by Ultrasonic Testing Machine.

9. Detection of cracks by Dye Penetration Technique.

10. Detection of cracks by Eddy Current Tester.

11. To perform Wear Test

* *Additional or any other experiment may be added based on contents of syllabi.

MACHINE DRAWING LAB

PME – 236

Course Outcomes (CO)		
1	Drafting their technical ideas.	CO1
2	Creating knowledge about the various practices with regard to the dimensioning, sectioning and development of views.	CO2
3	Preparation of the part and assembly drawings such as coupling, clutches, bearings, gear assemblies, I.C. engine components, valves, machine tools as per the conventions.	CO3
4	Understanding the importance of limits, tolerances and fits, surface finish, symbols for weldments, process flow, electrical and instrumentation units in the preparation of the part drawings.	CO4
5	Interpretation of machine drawings that in turn help the students in the preparation of the production drawings	CO5

A minimum of 08 experiments/sheets from the following:

Assembly and Part Drawings of simple assemblies and subassemblies of machine parts viz., couplings, clutches, bearings, gear assemblies, I.C. Engine components, valves, machine tools, etc.; IS/ISO codes;

Limits, tolerances and Fits, Surface finish; Symbols for weldments, process flow, electrical and instrumentation Units.

Introduction to solid modellers. A drawing project on reverse engineering.

References:

1. N.D. Bhatt, *Machine Drawing*, Charotar Book Stall, Anand, 1996.
2. N. Sidheswar, P. Kanniah and V.V.S. Sastry, *Machine Drawing*, Tata McGraw Hill, 1983.
3. *SP 46: 1988 Engineering Drawing Practice for School & Colleges*. Bureau of Indian Standards

COURSES AND EVALUATION SCHEME

YEAR II, SEMESTER IV
(B. Tech. Mechanical Engineering)

S. No.	COURSE CODE	SUBJECT	PERIODS			EVALUATION SCHEME				
						SESSIONAL EXAM			ESE	Subject Total
			L	T	P	CT	TA	Total		
A) THEORY										
1.	TAH-242	Engineering Mathematics-III	3	1	0	30	20	50	100	150
2.	TME-241	Applied Thermodynamics	3	1	0	30	20	50	100	150
3.	TME-242	Kinematics of Machines	3	1	0	30	20	50	100	150
4.	TME-243	Manufacturing Science -I	3	1	0	30	20	50	100	150
5.	TME-244	Mechanical Measurement & Control	3	1	0	30	20	50	100	150
B) PRACTICAL										
6.	PME-241	Applied Thermodynamics lab	0	0	2	10	15	25	25	50
7.	PME-242	Kinematics of Machine Lab	0	0	2	10	15	25	25	50
8.	PME-243	Manufacturing Science lab-I	0	0	2	10	15	25	25	50
9.	PME-244	Measurement Metrology and Control lab	0	0	2	10	15	25	25	50
10.	GPP-241	General Proficiency (NSS/NCC/Sports/Cultural)	-	-	-	-	50	50	-	50
SEMESTER TOTAL			**15**	**5**	**8**	**190**	**210**	**400**	**600**	**1000**

Mathematics –III

TAH-242

Course Outcomes (CO)		
1	Able to apply the subject knowledge in changing any one complex space into another complex space which is extremely useful in the present time.	CO1
2	Will be conversant in understanding the analytic functions.	CO2
3	Able to understand the behaviour of the materials and the flow of fluid.	CO3
4	Able to understand the statics and probability.	CO4
5	Able to understand the curve fitting and solution of equations.	CO5

Unit-I

Fourier transforms: Fourier transforms, Fourier sine and cosine transforms, Z transforms, inverse Z transform and its application to solve difference equation.

Unit-II

Function of a Complex Variable-I: Analytic functions, C-R equation, Harmonic functions, Line integral in the complex plane, Cauchy's integral theorem, Cauchy's integral formula for derivative of analytic function.

Unit-III

Function of a Complex Variable-II: Representation of a function by power series, Taylor's and Laurent's series, Poles, Residue theorem, evaluation of a real integral of type $\int_0^{2\Pi} f(\cos\theta, \sin\theta)d\theta$ and $\int_{-\infty}^{+\infty} f(x)dx$.

Unit-IV

Statistics and Probability: Correlation and Regression, Binomial distribution, Poisson distribution, Normal distribution. Conditional Probability, expectation theorem, Binomial expansion.

Unit-V

Curve Fitting and Solution of Equation: Method of least squares and curve fitting of straight line and parabola, Solution of cubic and bi-quadratic Equation.

References:

1. Advanced Engineering Mathematics, Kreyszig, Wiley India.
2. Engineering Mathematics, V. N. Kala & R. C. Bhadula, Scientific International Pvt. Ltd New Delhi.
3. Higher Engineering Mathematics, B. S. Grewal Khanna Publication.
4. Engineering Mathematics by Jain and Iyenger.

APPLIED THERMODYNAMICS

TME-241

Course Outcomes (CO)		
1	Able to understand the properties of steam (pure substances) and its applications. Able to analyse the various thermodynamic cycles and its applications.	CO1
2	Able to understand the steam generator and its various types, their mountings and accessories, having knowledge to calculate the heat balance for steam generators.	CO2
3	Able to understand and analysis the steam engine, steam nozzles, calculations for critical pressure critical temperature and effect of friction on nozzle and can interpretate the data	CO3
4	Able to understand and analyses the steam turbine, calculate force, power efficiency of the turbine, compounding and performance of turbine and interpretate the performance parameters.	CO4
5	Able to understand the gas turbine and jet propulsion, its working and have knowledge to calculate the force and efficiency, understand the factors for improving the performance efficiency.	CO5

Unit-I

Review of properties of steam and thermodynamics cycles: Pure substance, Property of steam, Triple point, Critical point, Sub-cooled liquid, Saturation states, Superheated states, Phase transformation process of water, Graphical representation of thermodynamic processes on p-T & p-V diagrams, T-s and h-s diagrams, Use of property diagram, Steam-Tables & Mollier charts, Dryness fraction and it's measurement, processes involving steam in closed and open systems, Simple Rankine cycle.

Unit-II

Boilers: Steam generators: classifications, working of fire-tube and water-tube boilers, boiler mountings & accessories, Draught & its calculations, air pre-heater, feed water heater, super heater, Boiler efficiency, Equivalent evaporation. Boiler trial and heat balance.

Condenser: Classification of condenser, Air leakage, Condenser performance parameters

Unit-III

Steam Engines: Rankine and modified Rankine cycles, Working of steam engine, Classification of steam engines, Indicator diagram, Saturation curve, Missing quantity, Heat balance.

Steam& Gas Nozzles: Flow through nozzle, Variation of velocity, area and specific volume, Choked flow, Throat area, Nozzle efficiency, off design operation of nozzle, Effect of friction on nozzle, Super saturated flow.

Unit-IV

Vapour Power cycles: Carnot vapour power cycle, Effect of pressure & temperature on Rankine cycle, Reheat cycle, Regenerative cycle, Feed water heaters, Binary vapour cycle, combined cycles, Cogeneration.

Steam Turbines : Classification of steam turbine, Impulse and reaction turbines, Staging, Stage and overall efficiency, Reheat factor, Bleeding, Velocity diagram of simple & compound multistage impulse & reaction turbines & related calculations: work done, efficiencies of Impulse and reaction Turbines, state point locus, Comparison with steam engines, Losses in steam turbines, Governing of turbines.

Unit-V

Gas Turbine: Gas turbine classification, Brayton cycle, Principles of gas turbine, Gas turbine cycles with inter-cooling, reheat and regeneration and their combinations, Stage efficiency, Polytropic efficiency, Deviation of actual cycles from ideal cycles.

Jet Propulsion: Introduction to the principles of jet propulsion, Turbojet and turboprop engines & their processes, Principle of rocket propulsion, Introduction to Rocket Engine. Introduction to ram jet and pulse jet

References:

1. Fundamentals of Thermodynamics, 7ed, w/CD, Sonntag, Wiley India
2. Thermodynamics, P k Shah, B S Publications
3. Basic and Applied Thermodynamics by P.K. Nag, Tata Mc Graw Hill Pub.
4. Thermal Engg. By P.L. Ballaney, Khanna Publisher
5. Theory of Stream Turbine by W.J. Kearton
6. Gas Turbine, by V. Ganeshan, Tata Mc Graw Hill Publishers.
7. Gas turbine Theory & Practice, by Cohen & Rogers, Addison Weslay Long man

KINEMATICS OF MACHINES

TME-242

Course Outcomes (CO)		
1	Analysing the degree of freedom of various mechanisms,	CO1
2	Drawing velocity and acceleration diagrams for different mechanisms,	CO2
3	Designing a suitable mechanism depending on application	CO3
4	Drawing displacement diagrams and cam profile diagram for followers executing different types of motions and various configurations of followers,	CO4
5	Selecting gear and gear train depending on application	CO5

Unit-I

Introduction: Links-types, Kinematics pairs-classification, Constraints-types, Degree of Freedom, Grubler's equation, linkage mechanisms, inversions of four bar linkage, slider crank chain and double slider crank chain.

Velocity in Mechanisms: Velocity of point in mechanism, relative velocity method, instantaneous point in mechanism, Kennedy's theorem, instantaneous center method.

Unit-II

Acceleration in Mechanisms: Acceleration diagram, Coriolis component of acceleration, Klein's construction for Slider Crank and Four Bar mechanism, Analytic method for slider crank mechanism.

Mechanisms with Lower Pairs: Pantograph, Exact straight line motion mechanisms- Peaucellier's, Hart and Scott Russell mechanisms, Approximate straight line motion mechanisms Grasshopper,Watt and Tchebicheff mechanisms.

Unit-III

Kinematics Synthesis of Planar Linkages: Movability of four bar linkages, Grashoff's law, graphical methods of synthesis – Two and Three position synthesis of four bar and slider crank mechanisms, Analytical method- Freudenstein's equation for function generation (three position**)**

Unit-IV

CAMS: Cams and Followers - Classification & terminology, Cam profile by graphical methods for uniform velocity, simple harmonic motion and parabolic motion of followers.

Friction drives: Introduction, belt and rope drives, open and crossed belt drives, velocity ratio, slip, power transmission, effect of mass of belt on power transmission, maximum power transmission, initial tension and maximum tension, pivots and collars, uniform pressure and uniform wear, clutches.

Unit-V

Gears: Classification & terminology, law of gearing, tooth forms, interference, under cutting, minimum number of teeth on gear and pinion to avoid interference, simple, compound and planetary gear trains.

Books and References:

1. Theory of machines and mechanisms-Ghosh & Mallik, East-West Press
2. Kinematics, Dynamics and Design of Machinery, 2ed, w/CD, Waldron, Wiley India
3. Theory of machines and mechanisms- S. S. Ratan, Tata Mc-Graw Hill
4. Theory of machines and mechanisms- Rao & Dukkipati,

MANUFACTURING SCIENCE-I

TME-243

Course Outcomes (CO)		
1	Able to explain the different forging operations. Able to calculate the forging force for forging operations	CO1
2	able to explain the different forming operations like rolling and their type, extrusion and their type, drawing and deep drawing etc. Able to analyse rolling, extrusion, drawing and deep drawing operations.	CO2
3	Able to explain the different sheet metal operations and the different dies used in sheet metal operations.	CO3
4	Able to explain explosive forming, electrohydraulic forming and electromagnetic forming. Able to explain the powder metallurgy processes like powder formation, blending, compacting, sintering and finishing. Able to explain the types and functions of jigs and fixtures. able to explain the process used in manufacturing of plastic components	CO4
5	Able to explain the different casting processes. Able to explain the different types of patterns and their allowances. Able to explain the different casting defects	CO5

Unit-I

Introduction: Importance of manufacturing, Economic & technological considerations in manufacturing. Classification of manufacturing processes, Materials & manufacturing processes for common items.

Metal Forming Processes: Elastic & plastic deformation, yield criteria, Hot working vs. cold working. Analysis (equilibrium equation method) of forging process for load estimation with sliding friction sticking friction and mixed condition for slab and disc. Work required for forging, Hand, Power, Drop Forging.

Unit-II

Metal Forming Processes (continued): Analysis of Wire/strip drawing and maximum- education, Tube drawing, Extrusion and its application. Condition for Rolling force and power in rolling, Rolling mills & rolled-sections. Design, lubrication and defects in metal forming processes.

Unit-III

Sheet Metal working: Presses and their classification, Die & punch assembly and press work methods and processes. Cutting/Punching mechanism. Blanking vs. Piercing. Compound vs Progressive die. Flat-face vs. Inclined-face punch and Load (capacity) needed. Analysis of forming process like cup/deep drawing. Bending & spring-back.

Unit-IV

Unconventional Metal forming processes: Unconventional metal forming processes such as explosive forming, electromagnetic, electro-hydraulic forming.

Powder Metallurgy: Powder metallurgy manufacturing process. The need, process, advantage and applications.

Jigs & Fixtures: Locating & Clamping devices & principles, Jigs and Fixtures and its applications.

Manufacturing of Plastic components: Review of plastics, and its past, present & future uses, Injection moulding, Extrusion of plastic section, Welding of plastics. Future of plastic & its applications. Resins & Adhesives.

Unit-V

Casting (Foundry): Basic principle & survey of casting processes. Types of patterns and allowances. Types and properties of moulding sand. Elements of mould and design considerations, Gating, Riser,

Runnes, Core. Solidification of casting,. Sand casting, defects & remedies and inspection. Cupola furnace. Die Casting, Centrifugal casting. Investment casting, CO_2 casting and Stir casting etc.

References:

1. Manufacturing Science by Ghosh and Mallik
2. Fundamentals of Modern Manufacturing, Groover, Wiley India

MECHANICAL MEASUREMENT AND CONTROL

TME -244

Course Outcomes (CO)		
1	Explain the basics of standards of measurement Limit, Fit and Tolerances industrial Application.	CO1
2	Identify the use of gauges and comparators.	CO2
3	Understand the significance of measurement system, errors, transducers, intermediate modifying and terminating devices.	CO3
4	Interpret measurement of field variables like Force, Torque and Pressure.	CO4
5	Comprehend the fundamentals of thermocouple and strain measurement. Able to solve mechanical and control system problems	CO5

Unit-I

Mechanical Measurements

Introduction: Introduction to measurement and measuring instruments, Generalized measuring system and functional elements, Units of measurement, static and dynamic performance characteristics of measurement devices, calibration, concept of error, sources of error.

Sensors and Transducers: Types of sensors, types of transducers and their characteristics.

Unit-II

Time related measurements: Counters, stroboscope, frequency measurement by direct comparison. Measurement of displacement

Measurement of pressure: Gravitational, directing acting, elastic and indirect type pressure transducers, Measurement of very low pressures.

Strain measurement: Types of strain gauges and their working, calibration.

Measurements of force and torque: Different types of load cells, elastic transducers, pneumatic & hydraulic systems.

Temperature measurement: Thermometers, bimetallic thermocouples, thermistors.

Measurement of geometric forms like straightness, flatness, roundness. Tool maker's microscope.

Unit-III

Metrology: Standards of linear measurement, line and end standards. Limit fits and tolerances. Interchangeability and standardization. Linear and angular measurements devices and systems Comparators, Limit gauges classification, Taylor's Principle of Gauge Design.

Interferometry: principle and use of interferometry, optical flat. Measurement of screw threads and gears.

Surface texture: quantitative evaluation of surface roughness and its measurement.

Unit-IV

Concept of Automatic Controls- Open loop & closed loop systems. Servomechanism. Block diagrams. Laplace Transform and its applications, force-voltage and force current analogy, Electrical analog of simple mechanical system

Time Response analysis: Standard test signals, time response of second order systems and their Specifications, P, PI and PID Controllers

Unit-V

Frequency response Analysis: Frequency response, correlation between time and frequency responses, polar and inverse polar plots, Bode plots. Nyquist stability criterion, assessment of relative stability: gain margin and phase margin, constant.

Stability Analysis: Concept of stability, Routh-Hurwitz criteria and its limitations.

References:

1. Theory and Design for Mechanical Measurements, 3ed, w/CD, Figliola, Wiley India
2. Beckwith Thomas G., Mechanical Measurements, Narosa Publishing House, N. Delhi.

3. Doeblein E.O., “Measurement Systems, Application Design”, McGraw Hill, 1990.
4. Nagrath & Gopal, “Control System Engineering”, 4th Edition, New age International.
5. B.C. Kuo , “Automatic Control System” Wiley India.

APPLIED THERMODYNAMICS LAB

PME-241

Course Outcomes (CO)		
1	To apply the knowledge of thermodynamics to perform experiments.	CO1
2	To understand the concepts of engineering measurements involved in thermodynamics.	CO2
3	To understand experimental techniques in the thermal sciences.	CO3
4	To organize and conduct an experimental investigation.	CO4
5	To analyse and present experimental results	CO5

A Minimum of 08 experiments out of following;

1. Study of Fire Tube boiler
2. Study of Water Tube boiler
3. Study and working of two stroke petrol Engine
4. Study and working of four stroke petrol Engine
5. Determination of Indicated H.P. of I.C. Engine by Morse Test
6. Prepare the heat balance for Diesel Engine test rig
7. Prepare the heat balance sheet for Petrol Engine test rig
8. Study and working of two stroke Diesel Engine
9. Study and working of four stroke Diesel Engine.
10. Study of Ignition system of an I. C. engine
11. Study of Velocity compounded steam turbine
12. Study of Pressure compounded steam turbine
13. Study of Impulse & Reaction turbine
14. Study of steam Engine model.
15. Study of Gas Turbine Model
16. Any other suitable experiment on thermodynamics

* *Additional or any other experiment may be added based on contents of syllabi.

KINEMATICS OF MACHINE LAB

PME-242

Course Outcomes (CO)		
1	Able to analyse the mobility of mechanisms.	CO1
2	Able to understand the velocity and acceleration relation geometrically.	CO2
3	Able to analyse the pressure variation with help of single slider crank mechanism.	CO3
4	Knowledge of various types of lower pair mechanisms.	CO4
5	Able to analyse and differentiate among the motion of several types of cams with various input motions.	CO5

A minimum of 08 experiments from the following:

1. Study of simple linkers/models/mechanisms.
2. Exp. on Mechanism
3. Design of 4-bar mechanism
4. Synthesis of Slider Crank Mechanism
5. Study of straight line mechanism
6. Exp. on Velocity acceleration.
7. Study of Ackerman-Devis Steering Mechanism
8. Exp. on Gears (tooth profile, interference etc.)
9. Design of Spur Gear, Helical Gear using Computer program
10. Exp. on Gear trains.
11. Exp. on cam.

* *Additional or any other experiment may be added based on contents of syllabi.

MANUFACTURING SCIENCE LAB -I

PME-243

Course Outcomes (CO)		
1	Able to design and fabricate the pattern for further work.	CO1
2	Able to design and fabricate the Green Sand Mould for further work.	CO2
3	Able to perform the pouring of liquid metal in to the mould.	CO3
4	Abe to perform Fettling process and finishing operations to obtain the clean casting.	CO4
5	Able perform Sand testing test like % of Clay test, % of Moisture test, permeability test and hardness test.	CO5

A minimum of 08 experiments out of following:

1. Design of pattern for a desired casting (containing hole)
2. Pattern making
3. Making a mould (with core) and casting.
4. Sand testing (at least one such as grain fineness number determination)
5. Injection moulding with plastics
6. Forging: hand forging processes.
7. Forging: power hammer study & operation
8. Tube bending with the use of sand and on tube bending m/c.
9. Press work experiment such as blanking/piercing, washer, making etc.
10. Wire drawing/extrusion on soft material.
11. Rolling-experiment.
12. Bending & spring back.
13. Powder metallurgy experiment.
14. Jigs & Fixture experiment.
15. Any other suitable experiment on manufacturing science / process / technique.

* *Additional or any other experiment may be added based on contents of syllabi.

MEASUREMENT METROLOGY AND CONTROL LAB

PME-244

Course Outcomes (CO)		
1	Able to use a Vernier calipers, micrometer and thermometer.	CO1
2	Able to measuring of different diameter.	CO2
3	Able to measuring a different angle.	CO3
4	Able to design and study of different limit gauge.	CO4
5	Able to get the knowledge about the different angular measurement using filler gauge	CO5

Note: Minimum 6 out of following:

1. Study & working of simple measuring instruments- Vernier calipers, Micrometer, Tachometer.
2. Measurement of effective diameter of a screw thread using 3 wire methods.
3. Measurement of angle using Sine bar & slip gauges.
4. Study of limit gauges.
5. Study & angular measurement using Bevel protector
6. Adjustment of spark plug gap using feeler gauges.
7. Study of dial indicator & its constructional details.
8. Use of dial indicator to check a shape run use.
9. Study and understanding of limits, fits & tolerances
10. Study of Pressure & Temperature measuring equipment.
11. Strain gauge measurement.
12. Speed measurement using stroboscope.
13. Flow measurement experiment.
14. Vibration/work measuring experiment.
15. Experiment on Dynamometers.

Note: Minimum 4 out of following, out of which at least two should be software based.

1. To determine response of second order systems for step input for various values of constant K using linear simulator Unit and compare theoretical and practical results.
2. To study P, PI and PID temperature controller for an oven and compare their performance.
3. To study and calibrate temperature using resistance temperature detector (RTD)
4. To study DC position control system
5. To study synchro-transmitter and receiver and obtain output V/S input characteristics
6. To determine speed-torque characteristics of an ac servomotor.
7. To study performance of servo voltage stabilizer at various loads using load bank.
8. To study behaviour of separately excited dc motor in open loop at various loads.

Software based experiments (Use MATLAB, LABVIEW software etc.)

9. To determine time domain response of a second order systems for step input and obtain performance parameters.
10. To plot root locus diagram of an open loop transfer function and determine range of gain, k for stability.
11. To plot a Bode diagram of an open loop transfer function.
12. To draw a Nyquist plot of an open loop transfers functions and examine the stability of the closed loop system.

* *Additional or any other experiment may be added based on contents of syllabi.

3rd Year Scheme and Syllabus

COURSES AND EVALUATION SCHEME

YEAR III, SEMESTER V
(B. Tech. Mechanical Engineering)

S. No.	COURSE CODE	SUBJECT	PERIODS			EVALUATION SCHEME				
						SESSIONAL EXAM			ESE	Subject Total
			L	T	P	CT	TA	Total		
A) THEORY										
1.	TME-351	Dynamics of Machine	3	1	0	30	20	50	100	150
2.	TME-352	Heat and Mass Transfer	3	1	0	30	20	50	100	150
3.	TME-353	Manufacturing Science II	3	1	0	30	20	50	100	150
4.	TME-354	Machine Design I	3	1	0	30	20	50	100	150
5.	TEE-356	Electrical Machines	3	1	0	30	20	50	100	150
B) PRACTICAL										
6.	PME-351	Dynamics of Machine Lab	0	0	2	10	15	25	25	50
7.	PME-352	Heat and Mass Transfer Lab	0	0	2	10	15	25	25	50
8.	PME-353	Manufacturing Science II Lab	0	0	2	10	15	25	25	50
9.	PEE-356	Electrical Machine Lab	0	0	2	10	15	25	25	50
10.	GPP-351	General Proficiency (NSS/NCC/Sports/Cultural)	-	-	-	-	50	50	-	50
SEMESTER TOTAL			**15**	**5**	**8**	**190**	**210**	**400**	**600**	**1000**

DYNAMICS OF MACHINES

TME-351

Course Outcomes (CO)		
1	The static, inertia and dynamic force analysis and can solve the related real-world problems. Draw the turning moment diagram, fluctuation of energy for different real power generating units	CO1
2	Statically balance the rotating and reciprocating masses. Dynamically balance the rotating and reciprocating masses.	CO2
3	Frictional study in Pivots and collars, clutches, Bearing and Belts. Mechanical brakes, dynamometers and can solve the related real-world problems	CO3
4	Able to deal with, Different types Governors, their function and applications.	CO4
5	The use of the gyroscopic couple in different applications of stability of aircraft, ships and automobile two and four-wheeler.	CO5

Unit-I

Force Analysis, Turning Moment & Fly wheel: Static force analysis of linkages, Equivalent offset inertia force, Dynamic analysis of slider crank & Bar mechanism. Piston and Crank effort, Inertia, Torque, Turning moment diagrams, Fluctuation of energy, Flywheel.

Unit-II

Balancing of machines: Static and dynamic balancing, Balancing of rotating and reciprocating masses, Primary and secondary forces and couples.

Unit-III

Friction: Pivot and collar friction, Friction circle, Single plate, Multiplate and Cone clutches, Michelle & Kingsbury thrust bearing and rolling contact bearing, Belts and pulleys, Flat and Vbelts, Design and selection.

Brakes and Dynamometers (Mechanical Type): External and internal shoe brakes, Band and Block brakes, Hydraulic brakes, Absorption and Transmission dynamometers.

Unit-IV

Governors: Dead weight and spring loaded governors, Sensitivity, Stability, Hunting, Isochronisms, Effort and Power, Friction and Insensitivity, Introduction to inertia governors.

Gyroscopic Motion: Principles, Gyroscopic acceleration, gyroscopic couple and Reaction. Effect of Gyroscopic couple upon the stability of aeroplanes, ship, two & four wheelers.

Unit-V

Vibration: Introduction, periodic motion, harmonic motion, superposition of simple harmonic motions, beats, free vibration, torsional vibrations, Damped vibrations, forced vibration, single degree freedom vibration system, Two degree freedom vibration system, Multi degree freedom vibration system.

References:

1. Theory of Machine: Thomas Bevan (Pearson)
2. Theory of Machine: S.S.Ratan (TMH)
3. Kinematics, Dynamics & Design of Machinery-Waldron (Pearson)
4. Mechanical Vibration –Magreb, Cengage India, New Delhi
5. Mechanical Vibration Practice with Basic Theory – V. Rama Murthy – Narosa Publishers
6. Machanical Vibrations – S.S. Rao, Pearson
7. Mechanical Vibration- Palm, Wiley India, New Delhi

HEAT & MASS TRANSFER

TME-352

Course Outcomes (CO)		
1	To identify, formulate and solve engineering problems involving heat and mass transfer.	CO1
2	To build up necessary background for understanding the physical behaviour of various modes of heat transfer like conduction, convection and radiation.	CO2
3	To understand the concepts of heat transfer through extended surfaces.	CO3
4	To understand the application of various experimental heat transfer correlations in Engineering calculations.	CO4
5	To learn the thermal analysis and sizing of heat exchangers.	CO5

Unit-I

Introduction to Heat Transfer: Concepts of heat flows: conduction, convection and radiation, effect of temperature on thermal conductivity of materials, introduction to combined heat transfer.

Conduction: One-dimensional general heat conduction equation in the cartesian, cylindrical and spherical coordinates. Initial and boundary conditions.

Steady State One-dimensional Heat conduction: Composite Systems in rectangular, cylindrical and spherical coordinates with and without energy generation, thermal resistance concept, Analogy between heat and electricity flow, thermal contact resistance, Overall heat transfer coefficient, critical thickness of insulation.

Unit-II

Types of fins, Fins of uniform cross-sectional area, errors of measurement of temperature in thermometer wells.

Transient Conduction: Transient heat conduction Lumped capacitance method, unsteady state heat conduction in one dimension only, Heisler charts.

Unit-III

Forced Convection: Basic concepts, hydrodynamic boundary layer, thermal boundary layer, flow over a flat plate, flow across a single cylinder and a sphere, flow inside ducts, empirical heat transfer relations, relation between fluid friction and heat transfer, liquid metal heat transfer.

Natural Convection: Physical mechanism of natural convection, buoyant force, and empirical heat transfer relations for natural convection over vertical planes and cylinders, horizontal plates and cylinders and sphere.

Unit-IV

Thermal Radiation: Basic radiation concepts, radiation properties of surfaces, black body radiation laws, shape factor, black-body radiation exchange, Radiation exchange between non-blackbodies in an enclosure, Infinite parallel planes, radiation shields.

Unit-V

Heat Exchanger: Types of heat exchangers, fouling factors, overall heat transfer coefficient, logarithmic mean temperature difference (LMTD) method, effectiveness-NTU method, compact heat exchangers.

Condensation and Boiling: Introduction to condensation phenomena, heat transfer relations for laminar film condensation on vertical surfaces and on a horizontal tube, boiling modes: pool boiling curve, forced convective boiling.

Introduction to Mass Transfer: Introduction: Fick's law of diffusion, steady state equimolar counter diffusion, steady state diffusion though a stagnant gas film.

References:

1. Elements of Heat transfer by Cengel, TMH
2. Heat and mass transfer, M.Thirumaleswar, Pearson

3. Fundamentals of Heat & Mass Transfer by Incropera Wiley India
4. Heat & Mass Transfer by Khurmi, Schand,New Delhi

MANUFACTURING SCIENCE-II

TME-353

Course Outcomes (CO)		
1	able to analyse and make needful calculations related to metal cutting in various machining processes which will provide them help optimising the required parameter and get the positive output.	CO1
2	able to differentiate between various types of machine tools along with their respective working principles and various processes which can be performed on several machine tools	CO2
3	Able to get detail knowledge of various grinding processes, finishing operations and to select particular abrasive tool for a particular material.	CO3
4	Able to get brief knowledge of joining various metals by the application of different processes, their working principles and to get knowledge of cutting various metals by using thermal energy.	CO4
5	Able to differentiate between conventional and unconventional machining processes and also identify the need for modern machining processes. Able to analyse the effect of process parameters on material removal rate (MRR) Draw variation in MRR with different process parameters.	CO5

Unit-I

Metal Cutting: Mechanics of metal cutting, Geometry of tool and nomenclature, ASA system Orthogonal vs. oblique cutting. Mechanics of chip formation, types of chips. Shear angle relationship. Merchant's force circle diagram. Cutting forces, power required. Cutting fluids/lubricants. Tool materials. Tool wear and tool life. Machinability. Brief introduction to machine tool vibration and surface finish. Economics of metal cutting.

Unit-II

Machine Tools:

(i) Lathe : Principle, types, operations, Turret/capstan, semi/Automatic, Tool layout.
(ii) Shaper, slotter, planer : operations & drives.
(iii) Milling : Milling cutters, up & down milling. Dividing head & indexing. Max chip thickness & power required.
(iv) Drilling and boring : Drilling, boring, reaming tools. Geometry of twist drills.

Unit-III

Grinding & super finishing:

(i) Grinding: Grinding wheels, abrasive, cutting action. Grinding wheel specification. Grinding wheel wear - attritions wear, fracture wear. Dressing and Truing. Max chip thickness and Guest criteria. Surface and Cylindrical grinding. Centerless grinding.
(ii) Super finishing: Honing, lapping, and polishing.

Limits, Fits & Tolerance and Surface-roughness: Introduction to Limits, Fits, Tolerances and IS standards, and surface-roughness.

Unit-IV

Metal Joining (Welding):

Survey of welding and allied processes. Gas welding and cutting, process and equipment. Arc welding: Power sources and consumables. TIG & MIG processes and their parameters. Resistance welding: spot, seam projection etc. Other welding processes such as atomic hydrogen, submerged arc, electroslag, friction welding. Soldering & Brazing.

Thermodynamic and Metallurgical aspects in welding and weld,. Shrinkage/residual stress in welds. Distortions & Defects in welds and remedies. Weld decay in HAZ.

Unit-V

Introduction to non-conventional Manufacturing Process: Benefits, application and working principle of EDM, ECM, LBM, EBM, USM. AJM, WJM. Similarly, non-conventional welding application such as LBW, USW, EBW, Plasma arc welding, Explosive welding. HERE- Explosive Forming

References:

1. Modern Machining Processes by P.C. Pandey & H.S. Shan
2. Manufacturing science by Degarmo, Wiley India
3. Manufacturing Technology Metal Cutting & Machine Tools by PN Rao, TMH
4. Manufacturing Process by Sontosh Bhatnagar, BSP Hyderabad

MACHINE DESIGN –I

TME-354

Course Outcomes (CO)		
1	Able to seek and learn the fundamentals of design, standardization and designation of commonly used engineering materials.	CO1
2	Able to apply the fundamentals of stress analysis, theories of failure and multidimensional fatigue failure criteria in the analysis and design of machine components.	CO2
3	Able to analyse and design structural joints and design of power transmission shafts carrying various elements with geometrical features.	CO3
4	Able to analyze and design mechanical springs and power screws like screw jack.	CO4
5	Able to seek and analyse the various aspects of design and also design some components in practical situation.	CO5

Unit-I

Introduction: Definition, Methods, standards in design & selection of preferred size. Selection of materials for static & fatigue loads, Materials for components subjected to creep, BIS system of designation of steels, steels, plastics & rubbers. AISI (American Iron & Steel Institution), ASTM rubber testing methods.

Unit-II

Design against static load: Modes of failure, Factor of safety, stress-strain relationship, principal stresses, theories of Failure.

Design against fluctuating load: stress concentration, stress concentration factors, Fluctuating/alternting stresses, fatigue failure, endurance limit, design for finite & infinite life, Soderberg & Goodman criteria.

Unit-III

Design of Joints: Welded joint, screwed joints, ecentric loading of above joints, Joint design for fatigue loading.

Shaft, keys & coupling: Design against static and fatigue loads, strength & rigidity design, Selection of square & flat keys & splines, rigid & flexible couplings.

Unit-IV

Mechanical springs: Design of Helical and leaf springs, against static & fatigue loading.

Design analysis of Power Screws: Form of threads, square threads, trapezoidal threads, stresses in screw, design of screw jack.

Unit-V

Introduction to Product Development & Design Process: Definition of Design, Design Process, Need Analysis, Need based developments, Design by Evolution, Technology based developments, Examples. Case Studies. Brain-storming.

References:

1. Design of Machine Elements : Bhandari, TMH
2. Machine design : Sharma & Aggarwal, Katsons publications
3. Mechanical Design, Theory and Metholodogy, Waldraon, BSP, Hyderabad
4. M/C Design : Maleev & Hartman
5. Machine Design, Robert L Norton, Pearson
6. Machine Design –U C Jindal, Pearson

ELECTRICAL MACHINES

TEE-356

Unit-I

Principles of Electro-mechanical Energy Conversion: Introduction, Flow of Energy in Electromechanical Devices, Energy in magnetic systems-Field energy & Co-energy, Singly-Excited Systems and Doubly-excited Systems-generalized expression of torque, reluctance and electromagnetic torques.

Unit-II

D. C. Machines: Constructing feature and principal of operation of shunt, series and compound generators and motors including emf equation and armature reaction. Performance characteristics of generators and motors, starting, speed control and breaking of motors. Two quadrant and four quadrant operation of motors, choice of DC motors for different applications, losses and efficiency.

Unit-III

Transformers: Construction, EMF equation, Principle of operation, phasor diagram on no-load, effect of load, equivalent circuit, voltage regulation, Losses and efficiency, Tests on transformers, Prediction of efficiency and regulation, Aoto transformers, Instrument transformers, Three phase transformers.

Unit-IV

Induction Motors: Rotating magnetic fields, Principle of operation, Equivalent circuit, Torque-slip characteristic, Starters for cage and wound rotor type induction motors, speed control and breaking, single phase induction motors and methods of starting.

Unit-V

Synchronous Machines: Construction, EMF, Effect of pitch and distribution, Armature reaction and determination of regulation of synchronous generators, Principle of motor operation, Effect of excitation on line current (V-curves). Methods of synchronization, Typical applications of AC motors in industries.

References:

1. I. J. Nagrath&D.P.Kothari, " Electrical Machines", Tata McGraw Hill.
2. Bhimbra P. S., "Electrical Machinery" Khanna Publication
3. A. E. Fitggerald, C. Kingsley Jr and Umans,"Electric Machinery" 6th Edition McGraw Hill, International Student Edition.
4. Irving L. Kosow, "Electric Machine and Tranformers", Prentice Hall of India.
5. M. G. Say, "The Performance and Design of AC machines", Pit man & Sons.
6. Bhag S. Guru and Huseyin R. Hizirogulu, "Electric Machinery and Transformers" Oxford University Press, 2001.
7. AshfaqHussain, "Electric Machines" DhanpatRai& Company

DYNAMICS OF MACHINE LAB

PME 351

Course Outcomes (CO)		
1	Able to calculate the height of the Porter Governor.	CO1
2	Able to calculate the mass required for static balancing.	CO2
3	Able to calculate the resultant mass required for dynamic balancing.	CO3
4	Able to explain the effect of gyroscopic couple on the airplane, Ships and two & four-wheeler stability.	CO4
5	Able to calculate the critical speed of shaft.	CO5

A minimum of 08 experiments from the following:

1. Design & drawing of a cotter joint.
2. Design & drawing of a knuckle joints.
3. Design & drawing of a simple screw jack.
4. Design of shaft for different loading conditions.
5. Design & drawing of rigid coupling (flanged type).
6. Design & drawing of a leaf spring for an automobile.
7. Design & drawing of a helical spring for a given application
8. Exp. on Governor.
9. Exp. on critical speed of shaft (whirling of shaft)
10. Exp. on Gyroscope
11. Exp. on Vibration (spring)
12. Balancing of Rotating and Reciprocating Masses

* *Additional or any other experiment may be added based on contents of syllabi.

HEAT & MASS TRANSFER LAB

PME-352

Course Outcomes (CO)		
1	To work on heat transfer equipment's and to apply the knowledge of heat transfer to perform experiments.	CO1
2	To understand the concepts of engineering measurements involved in heat transfer analysis.	CO2
3	To understand experimental techniques in the heat transfer analysis.	CO3
4	How to organize and conduct an experimental investigation.	CO4
5	How to analyse and present experimental results.	CO5

A minimum of 08 experiments from the following:

1. Conduction - Composite wall experiment
2. Conduction - Composite cylinder experiment
3. Convection - Pool Boiling experiment
4. Convection - Experiment on heat transfer from tube-natural convection.
5. Convection - Heat Pipe experiment.
6. Convection - Heat transfer through fin-natural convection.
7. Convection - Heat transfer through tube/fin-forced convection.
8. Determination of Stephan Boltzmann Constant
9. Determination of emissivity.
10. Heat exchanger - Parallel flow experiment
11. Heat exchanger - Counter flow experiment
12. Experiment on critical insulation thickness.
13. Conduction - Determination of thermal conductivity of fluids.
14. Conduction - Thermal Contact Resistance Effect.

* *Additional or any other experiment may be added based on contents of syllabi.

MANUFACTURING SCIENCE-II LAB

PME-353

Course Outcomes (CO)		
1	To familiarize students with the basic principles, and operations on various machine tools Lathe machine, Milling Machine, Shaper and surface grinding machine, drilling machine	CO1
2	To provide hands on training and designing for various shape generation/machine to produce desired products such as Bolt making, Gear making, slot/groove making and also surface finishing	CO2
3	To educate and train the students to develop the desired knowledge and skills in efficiently design the *welds* and produce quality and defect-free weld joints	CO3
4	To analyse, organize and present experimental results.	CO4
5	To enhance student's abilities of understanding of safety aspects of handling mechanical components/tools etc, and train them to deal all kinds of problems as a team unit.	CO5

A minimum of 08 experiments from the following:

1. Bolt (thread) making on Lathe machine.
2. Tool grinding (to provide tool angles) on tool-grinder machine.
3. Gear cutting on Milling machine.
4. Machining a block on shaper machine.
5. Finishing of a surface on surface-grinding machine.
6. Drilling holes on drilling machine and study of twist-drill.
7. Study of different types of tools and its angles & materials.
8. Experiment on tool wear and tool life.
9. Gas welding experiment
10. Arc welding experiment
11. Resistance welding experiment.
12. Soldering & Brazing experiment
13. Experiment on unconventional machining.
14. Experiment on unconventional welding.
15. Experiment on TIG/MIG Welding.
16. Macro and Microstructure of welding joints, HAZ.

* *Additional or any other experiment may be added based on contents of syllabi.

ELECTRICAL MACHINE LAB

PEE-356

A minimum of 08 experiments from the following:

1. To obtain magnetization characteristics of a DC shunt generator.
2. Load test on DC Shunt Generator.
3. Speed control of DC Shunt Motor.
4. Brake test on DC Shunt Motor.
5. Regulation characteristic of three - phase Alternator.
6. Open circuit and short circuit tests on Single - phase Transformer.
7. Load test on Single - phase Transformer
8. Scott connection for 3 phase to 2 phase conversion.
9. Speed control of three - phase Induction Motor.
10. Brake test on Single - phase Induction Motor.

**Additional or any other experiment may be added based on contents of syllabi.

COURSES AND EVALUATION SCHEME

YEAR III, SEMESTER VI

(B. Tech. Mechanical Engineering)

S. No.	COURSE CODE	SUBJECT	PERIODS			EVALUATION SCHEME				
						SESSIONAL EXAM			ESE	Subject Total
			L	T	P	CT	TA	Total		
A) THEORY										
1.	TME-361	Fluid Machinery	3	1	0	30	20	50	100	150
2.	TME-362	I. C. Engine	3	1	0	30	20	50	100	150
3.	TME-363	Machine Design II	3	1	0	30	20	50	100	150
4.	TME-364	Refrigeration and Air Conditioning	3	1	0	30	20	50	100	150
5.	TME -365	Operation Research	3	1	0	30	20	50	100	150
B) PRACTICAL										
6.	PME-361	Fluid Machinery Lab	0	0	2	10	15	25	25	50
7.	PME-362	I. C. Engine Lab	0	0	2	10	15	25	25	50
8.	PME-363	Machine Design II Lab	0	0	2	10	15	25	25	50
9.	PME-364	Refrigeration and Air Conditioning Lab	0	0	2	10	15	25	25	50
10.	GPP-361	General Proficiency (NSS/NCC/Sports/Cultural)	-	-	2	-	50	50	-	50
SEMESTER TOTAL			**15**	**5**	**8**	**190**	**210**	**400**	**600**	**1000**

FLUID MACHINERY

TME -361

Course Outcomes (CO)		
1	To analyse the force involved in impact of jet in several conditions.	CO1
2	To select a hydraulic turbine after application of available conditions.	CO2
3	To apply the physical laws of hydraulics in the selection and analysis pumps.	CO3
4	To know the analysis and application of positive displacement pumps.	CO4
5	To calculate various parameters like efficiency, specific speed, etc related to the above-mentioned machine and some other machine also.	CO5

Unit-I

Introduction: Application of momentum and momentum equation to flow through hydraulic machinery, Euler's fundamental equation.

Impact of jet: Introduction to hydrodynamic thrust of jet on a fixed and moving surface (flat & curved), effect of inclination of jet with the surface.

Hydraulic Turbines: Classification of turbines, Impulse turbines, constructional details, velocity triangles, power and efficiency calculations, governing of Pelton wheel.

Unit-II

Reaction Turbines: Fransis and Kaplan turbines, constructional details, velocity triangles, power and efficiency calculations, degree of reaction, draft tube, cavitation in turbines, principles of similarity, Unit and specific quantities, specific speed, performance characteristics, selection of water turbines. Bulb Turbines.

Unit-III

Centrifugal Pumps: Classifications of centrifugal pumps, vector diagram, work done by impeller, efficiencies of centrifugal pumps, specific speed, model testing, cavitation and separation, performance characteristics. Net positive suction head.

Unit-IV

Positive Displacement Pumps: Reciprocating pump theory, slip and coefficient of discharges, indicator diagram, effect and acceleration, work saved by fitting air vessels, comparison of centrifugal and reciprocating pumps, positive rotary pumps, Gear and Vane pumps, performance characteristics.

Unit-V

Other Machines: Hydraulic accumulator, Intensifier, Hydraulic press, Lift and Cranes, theory of hydraulic coupling and torque converters, performance characteristics.

Water Lifting Devices: Hydraulic ram, Jet pumps, Airlift pumps**,** water distribution systems.

References:

1. Fluid Mechanics and Hydraulic Machines by S C Gupta, Pearson
2. Fundmanetals of Fluid Mechanics by Munson, Pearson
3. Hydraulic Machines by Jagdish Lal, Metropolitan book co. pvt ltd.
4. Hydraulic Machines: Theory & Design, V.P.Vasandhani, Khanna Pub.
5. Hydraulic Machines by R K Rajput, S.Chand & co Ltd.
6. Hydraulic Machines by D S Kumar

I. C ENGINES

TME -362

Course Outcomes (CO)		
1	Able to explain different types of reciprocating internal combustion engine (ICE), their typical design features and performance characteristics.	CO1
2	Able to Understand various types of fuel supply and its components.	CO2
3	Able to Explain the characteristic of homogeneous combustion in SI engines and spray combustion in CI and SI engines.	CO3
4	Able to Describe the main components of exhaust emissions and explain the mechanisms of emission formation.	CO4
5	Able to Describe methods for reduction of exhaust emission and their relations to fuel fuel quality and engine performance.	CO5

Unit-I

Introduction to I.C Engines: Engine classification, Air standard cycles, Otto, Diesel, Dual Stirling and Ericsson cycles, Two and four stroke engines, SI and CI engines, Rotary engines, stratified charge engine, Fuel air cycles and their analysis, Actual cycles and their analysis, Valve timing diagram. Concept of variable compression ratio engines (VCR).

Fuels: Fuels for SI and CI engine, important qualities of SI engine fuels, Rating of SI engine fuels, Important qualities of CI engine fuels, Dopes, Additives, Gaseous fuels, LPG, CNG, Biogas, Producer gas, Alternative fuels for IC engines.

Unit–II

SI Engines: Carburetion, Mixture requirements, Carburettor types Theory of carburettor, MPFI,
Combustion in SI engine, Flame speed, Ignition delay, abnormal combustion and it's control, combustion chamber design for SI engines.
Ignition system requirements, Magneto and battery ignition systems, ignition timing and spark plug, Electronic ignition, battery and its types, Charging and discharging of batteries

Unit–III

CI Engine: Fuel injection in CI engines, Requirements, Types of injection systems, CRDI, Fuel pumps, Fuel injectors, Injection timings.
Combustion in CI engines, Ignition delay, Knock and it's control, Combustion chamber design of CI engines.
Scavenging in 2 Stroke engines, pollution and it's control.

Unit-IV

Engine Cooling: Different cooling systems, Cooling Towers, Radiators and cooling fans.
Lubrication: Engine friction, Lubrication principal, Type of lubrication, Lubrication oils, Crankcase ventilation.
Supercharging: Effect of altitude on power output, Types of supercharging.
Testing and Performance: Performance parameters, Basic measurements, Blow by measurement, Testing of SI and CI engines.

Unit-V

Compressors: Classification, Reciprocating compressors, Single and multi stage, Intercooling, Volumetric efficiency.
Rotary compressors, Classification, Centrifugal compressor, Elementary theory, Vector Diagram efficiencies, Elementary analysis of axial compressors.

References:

1. I.C. Engines by Ganeshan ,TMH
2. I C Engines by Ferguson, Wiley India
3. A Course in International Combustion Engines, by Mathur & Sharma, Dhanpat Rai & Sons.

4. Reciprocating and Rotary Compressors, by Chlumsky, SNTI Publications Czechoslovakia .
5. I.C Engine Analysis & Practice by E.F Obert.
6. I.C Engine, by Ganeshan, TMH
7. I.C Engine, by R. Yadav, Central Publishing House, Allahabad

MACHINE DESIGN-II

TME-363

Course Outcomes (CO)		
1	To analyse and design different types of gears i.e., spur, helical and worm gears with respect to tooth bending strength and surface strength specifications.	CO1
2	To analyse and design of hydrodynamic bearings and rolling contact bearings using design charts and can choose the appropriate bearing from the manufacturer's catalogue.	CO2
3	To analyse and design thin and thick pressure vessels and compounding of cylinders along with gasket joints.	CO3
4	To be able to design various I.C. engine parts in harmony with other constraints.	CO4
5	To analyse the importance of statistical consideration approach in design with accord to probability and normal distribution.	CO5

Unit-I

Spur Gears: Tooth forms, System of gear teeth, contact ratio, Standard proportions of gear systems, Interference in involute gears, Backlash, Selection of gear materials, Gear manufacturing methods, Design considerations, Beam strength of gear tooth, Dynamic tooth load, Wear strength of gear tooth, Failure of gear tooth, Design of spur gears, AGMA and Indian standards.

Helical Gears: Terminology, Proportions for helical gears, Beam strength and wear strength of helical gears, herringbone gears, crossed helical gears, Design of helical gears.

Worm Gears: Types of worms, Terminology, Gear tooth proportions, Efficiency of worm gears, Heat dissipation in worm gearing, Strength and wear tooth load for worm gears, Design of worm gearing.

Unit-II

Sliding Contact Bearing: Types, Selection of bearing, Plain journal bearing, Hydrodynamic lubrication, Properties and materials, Lubricants and lubrication, Hydrodynamic journal bearing, Heat generation, Design of journal bearing, Thrust bearing-pivot and collar bearing, Hydrodynamic thrust bearing.

Rolling Contact Bearing: Advantages and disadvantages, Types of ball bearing, Thrust ball bearing, Types of roller bearing, Selection of radial ball bearing, Bearing life, Selection of roller bearings, Dynamic equivalent load for roller contact bearing under constant and variable loading, Reliability of Bearing, Selection of rolling contact bearing, Lubrication of ball and roller bearing, Mounting of bearing.

Unit-III

Cylinders and Pressure Vessels: Thin cylinders, Thin Spherical Vessels, Thick Cylinders, Lame's equation, Clavarino's and Birnie's equation, Compound cylinder, Gaskets, Gasketed Joints, Unfired Pressure Vessels, Thickness of cylindrical and spherical shells

Unit-IV

IC Engine Parts: Selection of type of IC engine, General design considerations, Design of Cylinder and cylinder head; Design of piston, piston ring and gudgeon pin; Design of connecting rod; Design of centre crankshaft.

Unit-V

Statistical Considerations in Design: Frequency Distribution, Characteristic of frequency curves, Probability distribution, Normal acurve, Design and Natural Tolerances, reliability, Probabilistic approach to Design

References:

1. Mechanical Engineering Design – Joseph E. Shigely, McGraw Hill Publications
2. Design of Machine Memebers-Alex Valance and VI Doughtie, McGraw Hill Co.

3. Machine design-M.F. Spott, Prentice Hall India
4. Machine Design-Maleev and Hartman, CBS
5. Machine design -Black & Adams, Mc Graw Hill
6. Machine Design-Sharma and Agrawal, S.K. Katara & Sons
7. Design of Machine Elements-V.B. Bhandari, Tata McGraw Hill Co.

REFRIGERATION & AIR CONDITIONING

TME-364

Course Outcomes (CO)		
1	Able to Analyze, evaluate and compare the performances of complex vapor compression systems and air-craft refrigeration systems.	CO1
2	Able to Perform thermodynamic analysis of absorption refrigeration systems and steam jet refrigeration system.	CO2
3	Able to Classify & designate different types of refrigerants, select the best refrigerant for specific purposes. Evaluate the various sources of heat load on buildings and perform heat load estimation.	CO3
4	Able to Design summer and winter air conditioning systems.	CO4
5	Able to Understand the use and working of air-washer, cooling tower cold storage, water cooler etc	CO5

Unit-I

Refrigeration: Introduction to refrigeration system, Methods of refrigeration, Carnot cycle, Reversed Carnot cycle, Carnot refrigerator and heat pump Unit of refrigeration, Air Refrigeration cycle: Open and closed air refrigeration cycles, Bell Coleman or Reversed Brayton air refrigeration cycle, Aircraft refrigeration system, Classification of aircraft refrigeration system. Simple system, Boot strap refrigeration, Regenerative, Reduced ambient, Dry air rated temperature (DART). Steam jet refrigeration

Unit-II

Vapour Compression System: Modification in reversed Carnot cycle, Single stage system, Analysis of vapour compression cycle, use of T-s and p-h charts, Effect of change in suction and discharge pressures on C.O.P, Effect of sub cooling & superheating of suction vapour on performance of the cycle, Actual vapour compression cycle, Different configuration of multistage system, Cascade system.

Refrigerants: Classification, Nomenclature, Desirable properties of refrigerants, Common refrigerants, Secondary refrigerants and CFC free refrigerants.

Unit-III

Vapour Absorption system: Working Principal of vapour absorption refrigeration system, Comparison between absorption & compression systems, Ammonia – Water vapour absorption system, Lithium- Bromide water vapour absorption system, Comparison.

Unit-IV

Air Conditioning: Introduction to air conditioning, Psychrometric properties and their definitions, Psychrometric chart, Different Psychrometric processes, Sensible heat factor (SHF), By pass factor , Apparatus dew point (ADP), Thermal analysis of human body, Design considerations, Effective temperature and comfort chart, Cooling and heating load calculations, Infiltration & ventilation, Internal heat gain, Grand Sensible heat factor (GSHF)

Unit-V

Refrigeration Equipment & Applications: Elementary knowledge of refrigeration & air conditioning equipments e.g compressors, condensers, evaporators & expansion devices, Air washers, Cooling, towers & humidifying efficiency, Food preservation, cold storage, Freezers, Ice plant, Water coolers, Elementary knowledge of transmission and distribution of air through ducts and fans, Basic difference between comfort and industrial air conditioning.

References:

1. Refrigeration and Air conditioning by C.P Arora.TMH
2. Refrigeration and Air conditioning by Arora & Domkundwar.Dhanpat Rai
3. Refrigeration and Air conditioning by stoecker & Jones.

4. Refrigeration and Air conditioning by Roy J. Dossat.Pearson
5. Heating Ventilating and Air conditioning by Mcquiston
6. Thermal Environment Engg. by Kuhen, Ramsey & Thelked. Central Book Agency.

OPERATION RESEARCH

TME -365

Course Outcomes (CO)		
1	To identify and develop operational research models from the verbal description of the real system and to formulate a real-time situation into a mathematical model.	CO1
2	Understand the mathematical tools that are needed to solve optimization problems.	CO2
3	To understand the characteristics of different types of decision-making environments and the appropriate decision-making approaches and tools to be used in each type.	CO3
4	To understand the need and importance of modelling the industrial problem.	CO4
5	To Make right decisions in operations management using game theory, queuing theory, transportation models, assignment models and network analysis.	CO5

Unit-I

Introduction: Linear programming, Definition, scope of Operations Research (OR) approach and limitations of OR Models, Characteristics and phases of OR Mathematical formulation of L.P. Problems. Graphical solution methods.

Linear Programming Problems: The simplex method - slack, surplus and artificial variables. Concept of duality, Big-M method, Two-phase method, degeneracy, and procedure for resolving degenerate cases.

Unit-II

Transportation Problem: Formulation of transportation model, Basic feasible solution using different methods, Optimality Methods, Unbalanced transportation problem, Degeneracy in transportation problems, Applications of Transportation problems.

Assignment Problem: Formulation, unbalanced assignment problem, traveling problem.

Unit-III

Game Theory: Formulation of games, two person-Zero sum game, games with and without saddle point, Graphical solution (2x n, m x 2 game), dominance property, mixed strategy (3x3 or higher games).

Stochastic Inventory Models: Inventory models with deterministic demand, Inventory models with probabilistic demand.

Unit-IV

Queuing Theory: Queuing systems and concepts, Queuing system characteristics, classification of queuing situations; Kendall's notation, solution of queuing problems, single channel, single stage, finite and infinite queues with Poisson arrival and exponential service time, MMC, applications to industrial problems.

Unit-V

PERT-CPM Techniques: Network construction, determining critical path, floats, scheduling by network, project duration, variance under probabilistic models, prediction of date of completion, crashing of simple networks.

References:

1. Taha H. A. - Operations Research , Pearson
2. Operations Research: Principles and practice: Ravindran, Phillips & Solberg, Wiley India ltd
3. AM Natarajan, P.Balasubramani , ATamilaravari "Operation research" Pearson 2005
4. Introduction to operation research: Theory and Applications, Springer BSP, Hyderabad
5. S D Sharma-Operations Research, Kedarnath Ramnath
6. P. K. Gupta and D. S. Hira, "Operations Research", S. Chand.

FLUID MACHINERY LAB

PME-361

Course Outcomes (CO)		
1	Able to analyse the impact of jet.	CO1
2	Able to understand the Impulse and Reaction Turbines.	CO2
3	Capability to analyse different efficiency of turbines.	CO3
4	Knowledge of basic principles of pumps.	CO4
5	Able to analyse different type of hydraulic machinery.	CO5

A minimum of 08 experiments from the following:

1. Impact of Jet experiment.
2. Turbine exp. on Pelton wheel.
3. Turbine exp. on Francis turbine.
4. Turbine exp. on Kaplan turbine.
5. Exp. on reciprocating pump.
6. Exp. on centrifugal pump.
7. Exp. on Hydraulic Jack/Press
8. Exp. on Hydraulic Brake
9. Exp. on Hydraulic Ram
10. Study through first visit of any pumping station/plant
11. Study through second visit of any pumping station/plant.
12. Any other suitable experiment/test rig such as comparison & performance of different types of pumps and turbines.

* *Additional or any other experiment may be added based on contents of syllabi.

I. C. ENGINE LAB

PME-362

Course Outcomes (CO)		
1	Able to analysis various performance parameters of 4-stroke petrol engine.	CO1
2	Able to understand the various compressors.	CO2
3	Capability to analyse various fuels and additives for SI and CI engine.	CO3
4	Knowledge of basic principles of cooling, lubrication and ignition system.	CO4
5	Able to analyse different type fuel injection system	CO5

A minimum of 08 experiments from the following:

1. To calculate various performance parameters for 4 Stroke Petrol Engine
2. To prepare a Heat Balance sheet for 4 Stroke Petrol Engine
3. To perform Morse Test
4. To study Various Compressors
5. To study battery, Magneto Ignition System
6. To study Various Fuels and Additives for SI and CI Engine
7. To study Cooling Systems for Engines
8. To study Lubrication Systems for Engines
9. To study various fuel Injection Systems

* *Additional or any other experiment may be added based on contents of syllabi.

MACHINE DESIGN-II LAB

PME-363

Course Outcomes (CO)		
1	Able to analyse and design of different types of joints such as riveted, bolted and welded joint under different loading conditions.	CO1
2	Able to understand and design of thin & thick cylinders.	CO2
3	Capability to analyse and selection of bearings from manufacturer's catalogue.	CO3
4	Able to design and analyse engine parts and engine assembly like connecting rod and single plate clutch.	CO4
5	Able to design a shaft under some practical load conditions and to make a program for this in some high-level language or in excel spread sheets.	CO5

A minimum of 08 experiments from the following:

1. Design & drawing of Riveted joints for given operating conditions.
2. Design of an eccentrically loaded welded, riveted of bolted joint.
3. Design of bolted joint for fluctuating loads.
4. To study and Design of Differential Bevel Gear
5. To study Thin and Thick Pressure Vessels
6. To study of Sliding Contact Bearing
7. To study of Rolling Contact Bearing
8. Design of Connecting Rod of an IC Engine
9. Design a shaft used in some practical application, by actual working and loading conditions
10. Justify the design of single plate clutch of a engine assembly
11. Design software in some high level language or excel sheets for design of a component

* *Additional or any other experiment may be added based on contents of syllabi.

REFRIGERATION & AIR CONDITIONING LAB

PME-364

Course Outcomes (CO)		
1	Able to Calculate the C.O.P of V.C.R.S and compare it with the theoretical C.O.P calculated from refrigeration tables.	CO1
2	Able to Know the working of different types of compressors and expansion valves.	CO2
3	Able to Know about the different components used in air-conditioning.	CO3
4	Able to Correlate between specific humidity, absolute humidity and degree of saturation.	CO4
5	Able to Calculate by-pass factor of condenser & evaporator coil of a window type air-conditioner	CO5

A minimum of 8 experiments from the following:

1. Experiment on refrigeration test ring and calculation of various performance parameters.
2. To study different types of expansion devices used in refrigeration system.
3. To study different types of evaporators used in refrigeration systems.
4. To study basic components of air-conditioning system.
5. Experiment on air-conditioning test rig & calculation of various performance parameters.
6. To study air washers
7. Study of window air conditioner.
8. Study & determination of volumetric efficiency of compressor.
9. Visit of a central air conditioning plant.
10. Visit of cold storage.

* *Additional or any other experiment may be added based on contents of syllabi.

4th Year Scheme and Syllabus

COURSES AND EVALUATION SCHEME

YEAR IV, SEMESTER VII
(B. Tech. Mechanical Engineering)

S. No.	COURSE CODE	SUBJECT	PERIODS			EVALUATION SCHEME				
						SESSIONAL EXAM			ESE	Subject Total
			L	T	P	CT	TA	Total		
A) THEORY										
1.	TME -471	CAD/CAM	3	1	0	30	20	50	100	150
2.	TME-472	Energy Conservation	3	1	0	30	20	50	100	150
3.	TME-473	Mechanical Vibrations	3	1	0	30	20	50	100	150
4.	EME-47X	Elective I	3	1	0	30	20	50	100	150
5.	EME-47X	Elective II	3	1	0	30	20	50	100	150
B) PRACTICAL										
6.	PME-471	CAD/CAM lab	0	0	2	10	15	25	25	50
7.	PME-474	Industrial Training	0	0	2	10	15	25	25	50
8.	PME-475	Project(I)	0	0	2		50	50	50	100
9.	GPP-471	General Proficiency (NSS/NCC/Sports/Cultural)	-	-	2	-	50	50	-	50
SEMESTER TOTAL			**15**	**5**	**8**	**170**	**230**	**400**	**600**	**1000**

List of Electives

Elective-I

1. EME-471 Advanced Engineering Materials
2. EME-472 Advanced Welding Processes
3. EME-473 Micro-Electro Mechanical Systems
4. EME-474 Optimization Techniques in Engineering
5. EME-479 Artificial Intelligence
6. EPE-474 Non Destructive Testing

Elective-II

1. EME-475 Advanced Fluid Mechanics
2. EME-476 Finite Element Method
3. EME-477 Mechatronics
4. EME-478 Advance Operation Research
5. EPE-476 Operation Management
6. EPE-478 Total Quality Management

CAD/CAM

TME -471

Course Outcomes (CO)		
1	To Understand the basic fundamentals of computer aided design and manufacturing.	CO1
2	To learn 2D and 3D transformations of the basic entities like line, circle and ellipse etc.	CO2
3	To understand the geometric modelling techniques like solid modelling, surface modelling, feature based modelling etc. and to visualize how components before its manufacturing or fabrication.	CO3
4	To learn the part programming and use G and M codes efficiently, to learn importance of group technology, computer aided process planning or computer aided quality control.	CO4
5	To learn the overall configuration and elements of CIM system.	CO5

Unit-I

CAD Tools: Definition of CAD Tools, Types of system, CAD/CAM system evaluation criteria, input and output devices. Graphics standard, functional areas of CAD, Modeling and viewing, Review of C, C++, statements such as if else for while & switch, functions, pointernotations, structure & class, concept of OOPS.

Geometric Modelling: Output primitives- Bresenham's line drawing and Mid-point circle algorithms. Types of mathematical representation of curves, wire frame models wire frame entities parametric representation of synthetic curves hermite cubic splines Bezier curves B-splines rational curves.

Unit-II

Surface Modeling: Mathematical representation surfaces, Surface model, Surface entities surface representation, Parametric representation of surfaces, plane surface, rule surface, surface of revolution, Tabulated Cylinder.

Parametric Representation Of Synthetic Surfaces: Hermite Bicubic surface, Bezier surface, B-Spline surface, COONs surface, Blending surface , Sculptured surface, Surface manipulation – Displaying, Segmentation, Trimming, Intersection, Transformations (both 2D and 3D).

Geometric Modelling-3D: Solid modeling, Solid Representation, Boundary Representation (B-rep), Constructive Solid Geometry (CSG).

Unit-III

CAD/CAM Exchange: Evaluation of data – exchange format, IGES data representations and structure, STEP Architecture, implementation, ACIS & DXF.

Collaborative Engineering: Collaborative Design, Principles, Approaches, Tools, Design Systems. Introduction to CAD/CAE, Element of CAD, Concepts of integrated CAD/CAM, CAD Engineering applications, its importance & necessity. Finite Element Methods: Introduction and Application of FEM, Stiffness Matrix/ Displacement Matrix, One/Two Dimensional bar & beam element (as spring system) analysis.

Unit-IV

NC Part Programming: Manual (word address format) programming. Examples Drilling and Milling.

Unit-V

System Devices: Introduction to DC motors, stepping motors, feed back devices such as encoder, counting devices, digital to analog converter and vice versa.

Interpolators: Principle, Digital Differential Analysers. Linear interpolator, circulator Interpolator and its software interpolator. Control of NC Systems- Open and closed loops. Automatic control of closed loops with encoder & tachometers. Speed variation of DC motor. Adaptive control

References:

1. CAD/CAM Theory and Practice – Ibrahim Zeid ,TMH
2. CAD/CAM – Groover & Zimmers Pearson
3. Computer Oriented Numerical Methods – Rajaraman PHI Learning
4. CAD/CAM by

ENERGY CONSERVATION

TME- 472

Course Outcomes (CO)		
1	Able to identify the different types of energy audit, its basic components, instrumentation and techno economic analysis used in energy audit and also able to carry out energy audit of an industry/organization.	CO1
2	Able to describe the methods of analysis of fuel, different types and applications of insulation and refractories, types and mechanism of FBC boiler and also able to find losses and blow down in boiler.	CO2
3	Able to explain steam system, steam recovery system, cogeneration and trigeneration and also have knowledge of energy saving opportunities.	CO3
4	Able to describe waste heat recovery, refrigeration and air conditioning system and different types of compressed air system, its efficiency and energy saving opportunities.	CO4
5	Able to explain electrical system, electrical billing, power factor, types of electric motors, losses and efficiency in motors and also have a knowledge about energy saving opportunities in motors	CO5

Unit-I

Energy Audit: Definition, Need and Objectives.

Types of Energy Audit: Internal Audit, External Audit, Walk through Energy Audit, Preliminary Energy Audit, Detailed Energy Audit, Industrial Energy Audit, Utility (Services) Energy Audit, Commercial Energy Audit, Residential Energy Audit.

Basic Components of Energy Audit: Preparing for Audit Visit, Instrumentation, Data Collection Technoeconomic Analysis, Safety Considerations.

Unit-II

Fuel Analysis: Proximate Analysis, Ultimate Analysis, Calorific Value. Combustion: Theoretical Air Requirement.

Insulation and Refractories: Insulation Type and Application, Economic Thickness of Insulation, Heat Savings and Application Criteria, Refractory-Types, Selection and Application of Refractories.

Boilers: Types, FBC Boilers ,Mechanism of Fluidized Bed Combustion, Saving Potential. Analysis of Losses, Performance Evaluation, Blow Down, Energy Conservation OpportUnities.

Unit-III

Steam System: Properties of Steam, Assessment of Steam Distribution Losses, Steam Leakages, Steam Trapping, Condensate and Flash Steam Recovery System, Identifying OpportUnities for Energy Saving.

Cogeneration and Trigeneration: Need, Applications, Advantages, Combined Cycles, Saving Potential.

Unit-IV

Waste Heat Recovery: Availability and Reversibility, First and Second Law Efficiencies, Classification, Advantages and Applications, Commercially Viable Heat Recovery Devices, HVAC and Refrigeration System, Factors Affecting Refrigeration and Air Conditioning System Performance and Savings OpportUnities. Distribution systems for conditioned air.

Compressed Air Systems: Types of air compressors, compressor efficiency, efficient compressor operation, compressed air systems components, capacity assessment, leakage test, factors affecting the performance and energy savings opportUnities.

Unit-V

Electrical Systems: Active power, reactive power and apparent power, star, delta connection, electrical load management and electrical billing

Power Factor: Power factor, Power factor improvement and its benefit, selection and location of capacitors, and energy conservation opportUnities.

Electric Motors: Types, losses in induction motors, motor efficiency, factor affecting motor performance, rewinding and motor replacement issues, energy saving opportUnities in motors, energy efficient motors, soft starter with energy savers.

References:

1. G. L. Witte, Phillips S.Scbmidt and Daid R. Brown, Industrial Energy Management and Utilization, Hemisphere Publishing Corporation, Washington
2. Carig,B. Saith, Energy Management Principles, Applications, Bnefit and Saving, Per n Press, New York.
3. F. W. Pyne, P *gm* Energy Conservation Manual, Fairmont Proem, INC.P.O. Box 14227 Atlanta,GA 30224
4. D. Patrick and S.W. Fardo, Energy U-sent and Conservation, Prentice Hall, INC Engleweek Cliffs (NJ) 7632.
5. W R Murphy & G McKay, Energy Management, Elsiver/BSP hyderabad

MECHANICAL VIBRATIONS

TME-473

Course Outcomes (CO)		
1	Able to analyse the natural frequency.	CO1
2	Able to understand the single degree of free and force vibration system.	CO2
3	Capability to analyse different type absorbers.	CO3
4	Able to understand the multi degree of free and force vibration system.	CO4
5	Able to analyse continuous vibration system & Understand the critical speed	CO5

Unit-I

Introduction: Periodic motion, harmonic motion, superposition of simple harmonic motions, beats, fourier Analysis. Single Degree Freedom System: Free vibration, Natural frequency, Equivalent Systems, Energy method for determining natural frequency, Response to an initial disturbance. Torsional vibrations, Damped vibrations. Damping models – Structural, Coulomb and Viscous damping, Vibrations of system with viscous damping, Logarithmic decrement, Viscous dampers.

Unit-II

Single Degree Freedom: Forced vibration, Harmonic Excitation with viscous damping, Steady state vibrations.Forced vibrations with rotating and reciprocating unbalance, Support excitation.Vibration isolation, Transmissibility, Vibration measuring instruments- Displacement, Velocity, Acceleration and Frequency measuring instrument.

Unit-III

Two Degree Freedom System: Introduction, Principal modes, Double pendulum, Torsional system with damping. Coupled System, Undamped dynamic, vibration absorbers, Centrifugal pendulum absorber, Dry friction damper, Untuned viscous damper.

Unit-IV

Multidegree Freedom System: Exact Analysis Undamped free and forced vibrations of multidegree system. Influence numbers, Reciprocal Theorem, Torsional vibration of multi rotor system, Vibration of geared system. Principal coordinates, Continuous systems- Longitudinal vibration of bars, Torsional vibrations of Circular shafts, Lateral vibration of beams.

Unit-V

Multidegree Freedom System: Numerical Analysis Rayleigh's, Dunkerley's, Holzer's and Stodola's methods, Rayleigh – Ritz method. Critical Speed of Shafts: Shafts with one disc with and without damping, Multi-disc shafts, Secondary critical speed.

References :

1. Mechanical Vibration –Magreb, Cengage India, New Delhi
2. Mechanical Vibration Practice with Basic Theory – V. Rama Murthy – Narosa Publishers
3. Machanical Vibrations – S.S. Rao, Pearson
4. Mechanical Vibration- Palm, Wiley India, New Delhi

ADVANCED ENGINEERING MATERIALS

EME-471

Course Outcomes (CO)		
1	Able to describe metallic and non-metallic materials.	CO1
2	Able to explain preparation of high strength materials.	CO2
3	Able to suggest materials for low and high temperature applications.	CO3
4	Able to integrate knowledge of different types of advanced engineering materials	CO4
5	Able to analyse problem and find appropriate solution for use of materials.	CO5

Unit-I

Ferrous Materials, their Properties and Applications: Plain carbon steels, their properties and application: plain carbon steels, effects of alloying elements in plain carbon steels. Alloy steels, tools steels, stainless steels, low and high temperature resisting steels, high strength steels, selections, specifications, form and availability of steel. Cast irons-white, grey, modular malleable and alloy cast irons. Recognized patterns of distribution of graphite flakes in grey cast iron.

Unit-II

Heat Treatment of Steels: TTT diagrams, annealing, normalizing, hardening and tempering of steel. Austempering and martempering of steel. Hardenability, Journing end quench test. Grauisis and its determination. Effect of grain size on the properties of steel.

Surface hardening of steel: Carbonising nitriding carbonitriding cyniding, induction hardening microscopic determination of case depth and depth of hardening.

Unit-III

Nonferrous materials, their properties and application, brasses, bronzes, cu-nickel alloys, aluminum, magnesium and titanium alloys, bearing materials, selection, specific form and availability. Heat treatment of nonferrous materials –precipitation hardening.

Unit-IV

Composites Polymer– polymer, metal-metal, ceramic –ceramic, ceramic-polymer, metal-ceramic, metal polymer composites. Dispersion reinforced, particle reinforced, laminated and fibre reinforced composites.

Unit-V

Properties and identifications of different types of rubbers vulcanisation, fabrication and forming techniques of rubber. Introduction of plastics and ceramics – types, application and process. Smart materials-introduction and types. Selection of materials and factors affecting deflection, Selection process and systematic evaluation.

References:

1. Raghavan V.,"Materials Science and Engineering- A first Course," 5th edition, ISBN:978-81-203-2455-8
2. Askeland D.R., "The Science and Engineering of Materials, 5th edition, ISBN: 978-81-315-0321-8
3. Callister W.D., "Materials Science and Engineering" Wiley India (P) Ltd. ISBN:978-81-265-21-43-2.
4. Material Science by Avner.

ADVANCE WELDING PROCESSES

EME-472

Course Outcomes (CO)		
1	Able to get the knowledge of various conventional and advanced welding techniques which make them interested to choose a career in the field of welding.	CO1
2	Able to familiar with various welding process parameters and techniques and capable to select most suitable welding procedure and consumables for a product/process.	CO2
3	Able To understand the advanced welding practices in Industries and their comparative merits and demerits	CO3
4	Able to develop the knowledge and skills in advanced welding processes, weld design using the various thermal and metallurgical considerations against various defects and final quality testing of weldments to secure employments.	CO4
5	Able to choose the choose appropriate welding processes, right kind of welding techniques, weld design to minimize the occurrence of various weld defects or distortion with the aim of maximizing process efficiency and weld quality.	CO5

Unit-I

Introduction: Importance and application of welding, classification of welding process. Selection of welding process. Review of conventional welding process : Gas welding, Arc welding, MIG, TIG welding. Resistance welding. Electroslag welding, Friction welding etc. Welding of MS.CI, Al, Stainless steel & Maurer/Schacfflar Diagram. Soldering & Brazing.

Unit-II

Advanced welding Techniques: Principle, working and application of advanced welding techniques such as Plasma Arc welding, Laser beam welding, Electron beam welding, Ultrasonic welding etc.

Unit-III

Advanced welding Techniques (continued): Principle and working and application of advanced welding techniques such as explosive welding/ cladding, Underwater welding, Spray welding /Metalizing, Hard facing.

Unit-IV

Weld Design: Welding machines/equipments and its characteristics. Weld defects and distortion and its remedies, Inspection/testing of welds, Macrostructure & microstructure of welds, HAZ, Weld Design, Welding of pipe-lines and pressure vessels. Life predication.

Unit-V

Thermal and Metallurgical consideration. Thermal considerations for welding, temperature distribution, Analytical analysis, heating & cooling curves. Metallurgical consideration of weld, HAZ and Parent metal, micro & macro structure. Solidification of weld and properties.

References:

1. "Welding Handbook", 7th Edition-Volume l to 5, American Welding Society.
2. Houdlecroft P.T., "Welding Process Technology", Cambridge University Press.
3. Bowditch, W.A., Bowditch M. A., Bowditch, K. E., "Welding Technology Fundamentals", 4th Edition, Goodheart-Willcox Pub.
4. Baldev, R., "Welding Technology for Engineers", ASM International
5. Rossi E., "Welding Technology", Mc-Graw Hill.

MICRO-ELECTRO MECHANICAL SYSTEMS

EME-473

Course Outcomes (CO)		
1	Able to describe new applications and directions of modern engineering.	CO1
2	Able to describe the techniques for building microdevices in silicon, polymer, metal and other materials.	CO2
3	Able to describe the physical, chemical, biological, and engineering principles involved in the design and operation of current and future microdevices.	CO3
4	Able to critically analyse microsystems technology for technical feasibility as well as practicality.	CO4
5	Able to describe the limitations and current challenges in microsystems technology.	CO5

Unit-I

Overview of MEMS and Microsystems: MEMS and Microsystems, Microsystems and Microelectronics, Microsystems and miniaturization, Application of Microsystem**.** Working Principles of Microsystem: Microsensors- Acoustic wave sensors, biomedical sensors and bio sensors, chemical sensors, optical sensors, pressure sensors, thermal sensors. Microactuation- actuation using thermal forces, actuation using shape-memory alloys, actuation using piezoelectric crystals, actuation using electrostatic forces. MEMS and Micro actuators- Micro grippers, micromotors, microvalves, micropumps, microaccelerometers, Microfluidics.

Unit-II

Materials for MEMS and Microsystems: substrates and wafers, active substrate materials, silicon as a substrate material- the ideal substrate for MEMS, single crystal silicon and wafers, crystal structure, the miller indices, mechanical properties of silicon. Silicon compounds- silicon dioxide, silicon carbide, silicon nitride, polycrystalline silicon Silicon piezoresistors, Gallium arsenide, polymers for MEMS and Microsystems, conductive polymer, the Langmuir-Blodgett film, packaging materials.

Unit-III

Microsystems Fabrication Processes: Photolithography-photo resists and application, light sources, photo resist development, photo resist removal and post baking. Ion implantation, diffusion, oxidation-thermal oxidation, silicon dioxide, thermal oxidation rates, oxide thickness by color ; Chemical vapor deposition- working principle of CVD, chemical reaction s in CVD, rate of deposition, enhanced deposition ; physical vapor deposition- sputtering ;Deposition by epitaxy ; Etching- Chemical etching, plasma etching

Unit-IV

Micro manufacturing: Bulk Manufacturing- overview of etching, isotropic and anisotropic etching, wet etchants; etch stop, dry etching, and comparison of wet versus dry etching. Surface micromachining- general description, process in general, mechanical problems associated with surface micromachining. The LIGA Process- general description of the LIGA process, materials for substrates and photo resists, electroplating. The SLIGA process.

Unit-V

Microsystems Design: Design Considerations- Design constraints, selection of materials, selection of manufacturing processes, selection of signal transduction, electromechanical system and packaging
Process design- photolithography, thin film fabrications, geometry shaping, Mechanical design- thermo mechanical loading, thermo mechanical stress analysis, dynamic analysis, interfacial fracture analysis. Design of micro fluidic network systems- fluid resistance in microchannels, capillary electrophoresis network systems, mathematical modeling of capillary electrophoresis network systems

References:

1. MEMS & Microsystems Design and Manufacture By Tai-Ran Hsu Tata McGraw-Hill

2. Pelesko, J.A., and Bernstein D.H., "Modeling MEMS and NEMS", 1st Ed., Chapman and Hall CRC
3. Beeby, S., Ensell, G., Kraft, M., and White N., "MEMS Mechanical Sensors", 1st Ed., Artech House, Inc.
4. Bao, M., "Analysis and Design Principles of MEMS Devices", 1st Ed., Elsevier B.V.
5. Mohamed Gad-el-Hak (Editor), "The MEMS Handbook", 2nd Ed., Taylor and Francis.
6. Adams, T.M., and Layton, R.A., "Introductory MEMS: Fabrication and Applications", Springer New York.

OPTIMIZATION TECHNIQUES IN ENGINEERING

EME-474

Course Outcomes (CO)		
1	Able to define and use optimization terminology and concepts, and understand how to classify an optimization problem.	CO1
2	Able to demonstrate the ability to choose and justify optimization techniques that are appropriate for solving realistic engineering problems.	CO2
3	Able to understand and apply unconstrained optimization theory for continuous problems, including the necessary and sufficient optimality conditions and algorithms	CO3
4	Able to understand and apply gradient-free and discrete optimization algorithms.	CO4
5	Able to apply optimization techniques to determine a robust design.	CO5

Unit-I

Unconstrained Optimization: Optimizing Single-Variable Functions, conditions for Local Minimum and Maximum, Optimizing Multi-Variable Functions.

Unit-II

Constrained Optimization: Optimizing Multivariable Functions with Equality Constraint: Direct Search Method, Lagrange Multipliers Method, Constrained Multivariable Optimization with inequality constrained: Kuhn-Tucker Necessary conditions, Kuhn –Tucker Sufficient Conditions.

Unit-III

Optimization: Quasi-Newton Methods and line search, least squares optimization, Gauss Newton, Levenberg-Marquartd, Extensions of LP to Mixed Integer Linear Programming (MILP), Non-Linear Programming, The Newton Algorithm, Non-Linear Least Squares, Sequential Quadratics Programming (SQP), Constrained Optimization, SQP Implementation, Multi-Objective Optimization, Branch and Bound Approaches, Genetic Algorithms and Genetic Programming, Singular Based Optimization, On-Line Real- Time Optimization, Optimization in Econometrics Approaches – Blue.

Unit-IV

Optimization and Functions of a Complex Variable and Numerical Analysis: The Finite Difference Method for Poisson's Equation in two Dimensions and for the Transient Heat Equation, Eulers Method, The Modified Euler Method and the Runge-Kutta Method for Ordinary Differential Equations, Gaussian Quardative Trapezoidal Rule and Simpson's 1/3 and 3/8 Rules, the Newton Raphson in one and two Dimensions, Jacobi's Iteration Method.

Unit-V

Optimization in Operation Research: Dynamic Programming, Transportation – Linear Optimization Simplex and Hitchcock Algorithms, Algorithms, Minimax and Maxmin Algorithm, Discrete Simulation, Integer Programming – Cutting Plane Methods, Separable Programming, Stochastic Programming, Goal Programming, Integer Linear Programming, Pure and Mixed Strategy in theory of Games, Transhipment Problems, Heuristic Methods.

References:

1. Winston W L: Operations Research: Applications and Algorithms
2. Rao S.S., Optimization: Theory and Applications.
3. Walsh G R: M methods of Optimization.

ARTIFICIAL INTELLIGENCE

EME-479

Course Outcomes (CO)		
1	Able to demonstrate knowledge of the building blocks of AI as presented in terms of intelligent agents.	CO1
2	Able to analyse and formalize the problem as a state space, graph, design heuristics and select amongst different search or game-based techniques to solve them.	CO2
3	Able to Develop intelligent algorithms for constraint satisfaction problems and also design intelligent systems for Game Playing	CO3
4	Able to attain the capability to represent various real-life problem domains using logic-based techniques and use this to perform inference or planning.	CO4
5	Able to formulate and solve problems with uncertain information using Bayesian approaches.	CO5

Unit-I

Overview of History and Goals of AI: Artificial Intelligence -- Definition, components, scope, and application areas; Turing's test; Review of AI success and failure.

Unit-II

State Spaces, Production Systems, and Search: State space representation of problems; Problem solving using search; Definition and examples of production systems; Heuristic search techniques i.e. generate-and-test, hill climbing, best-first search, constraint satisfaction and mean-ends analysis.

Unit-III

Knowledge Representation: Definition of knowledge; Issues in knowledge representation; Procedural vs declarative knowledge and their representation; Predicate logic, production rules, semantic nets, and frames; Meta-knowledge.

Unit-IV

Reasoning and Inference Strategies: Forward vs backward reasoning; Depth first, breadth first, min-max etc.; Non-monotonic reasoning; Symbolic reasoning under uncertainty; Probability and Baye's theorem; Certainty factors, Dempster-Shafer theory; Fuzzy logic etc.

Unit-V

Expert Systems and their Applications: Justification, structure, knowledge sources; Expert knowledge acquisition; Expert system languages; ES building tools/shells; Applications of AI in CAD, CAPP, process selection, GT, MRP II, adaptive control, robotics, process control, fault diagnosis, failure analysis, etc.

References:

1. Rich, E., Knight, K. and Nair, S. B., "Artificial Intelligence", 3rd Ed., Tata McGraw Hill.
2. Russell, S. and Norvig, P., "Artificial Intelligence: A Modern Approach", 3rd Ed., Prentice-Hall.
3. Dean, T. L., Allen, J., and Aloimonos, Y. "Artificial Intelligence: Theory and Practice", Benjamin/Cummings Publishing Company.
4. Genesereth, M. R. and Nilsson, N., "Logical Foundations of Artificial Intelligence", Morgan Kaufmann.

NON DESTRUCTIVE TESTING

EPE-474

Course Outcomes (CO)		
1	Ability to apply scientific and technical knowledge to the field of non-destructive testing.	CO1
2	Ability to use the relevant non-destructive testing methods for various engineering practice.	CO2
3	Ability to recognize and achieve high levels of professionalism in their work.	CO3
4	Recognition of the need and ability to engage in lifelong learning, thought process and development	CO4
5	Able to monitor, improve or control manufacturing processes.	CO5

Unit-I

Introduction: Scope and advantages of N.D.T. some common NDT methods used since ages – visual inspection, Ringing test, and chalk – test (oil-whiting test) their effectiveness in detecting surface cracks, bond strength and surface defects.

Unit-II

Common NDT methods: Dye – penetrant tests – principle, scope, equipment and techniques. Zyglo testing. Magnetic Particle Tests- Scope of test, Principle equipment and technique. DC And AC magnetization, use of day and wet powders magnaglow testing. Interpretations of results.

Unit-III

Radiographic Methods: X-ray radiography – principle, equipment and methodology. Interpretation of radiographs, Limitations Gamma ray radiography. Principle, equipment, source of radioactive material and technique. Precautions against radiation hazards, Advantage over x-ray radiography methods.

Unit-IV

Ultrasonic Testing Methods: Introduction Principle of Operation – piezoelectricity. Ultrasonic probes, cathode ray oscilloscope techniques and advantages limitation and typical applications.

Unit-V

Testing of castings, forgings &weldments Application of NDT methods in inspection of castings, forging sand welded structures with illustrative examples. Case studies. Sample-testing in the lab.

References:

1. Nondestructive Testing, Louis Cartz, ASM International
2. Nondestructive Evaluation and Quality Control, ASM Handbook, Vol. 17.

ADVANCED FLUID MECHANICS

EME-475

Course Outcomes (CO)		
1	Able to understand the concept of fluid and the models of fluids.	CO1
2	Able to understand the basic physical meaning of general equations.	CO2
3	Able to understand the concept of stream function and potential function.	CO3
4	Ability to derive the equation for viscous flow, including laminar flow and turbulent flow.	CO4
5	Ability to address such problems in engineering, and to solve the problems.	CO5

Unit-I

Review of kinematics of fluid motion, method of describing fluid motion, translation, rate of deformation, the material derivatives, acceleration, vorticity in Cartesian & polar coordinates, Reynolds transport theorem, Stress at a point, velocity profile, wall shear stress.

Unit-II

Non-viscous incompressible flow: Equation of continuity, Euler's equation of motion, Bernoulli's equation, circulation and its theorem, stress function, velocity potential, irrotational flow, two dimensional source, sink, source-sink pair, doublet vortex, superposition of source sink with rectilinear flow, Rankine body, Superposition of rectilinear flow and doublet, flow around a spinning circular cylinder, Magnus effect, lift & Drag, Skin friction. Lift of aerofoil.

Unit-III

Boundary layer Concept: Introduction to boundary layer formation, Novier-stokes equation, Boundary layer thickness, momentum thickness, energy thickness, Boundary layer equations, Momentum-Integral equation - Von Korman, Blasius solution of boundary layer on a flat plate without pressure gradient, Flow with very small Reynolds number, Hogen poisseuille flow, Plane Couette flow, Hydrodynamic theory of lubrication.

Unit-IV

Compressible flow: Propagation of pressure change, sound velocity, elastic waves, Mach number, Mach cone, isentropic flow relations in terms of sonic velocity and mach number, Stagnation properties, Regions of flow, Energy equation, Effect of Mach number on compressibility. Propagation of infinitesimal waves, Non-steep finite pressure wave and steep finite pressure waves, Expansion waves Isentropic flow with variable area, Mach number variation and its effect on Flow through nozzles and diffusers. Area ratio, impulse function, Use of Gas/Air tables.

Unit-V

Flow with normal shock waves: Development of shock wave, rarefaction wave, governing equations, Prandtle-Meyer relation. Thermodynamic properties across shock. Wind tunnels. Flow in constant area duct with friction-Fanno curves, Fanno flow equations, Solution of fanno flow equations. Variation of flow properties. Tables & charts for Fanno flow. Flow in constant area duct with heat transfer- Rayleigh line, Fundamental equations, Rayleigh flow relation, Variation of flow properties. Tables & Charts for Rayleigh flow.

References:

1. Fluid Mechanics by White.
2. Fluid Mechanics by Streeter
3. Fluid Mechanics by Som & Biswas
4. Fluid Mechanics by K.L. Kumar
5. Gas Dynamics by E. Radhakrishnan

FINITE ELEMENT METHOD

EME-476

Course Outcomes (CO)		
1	To understand the principles, concepts and importance of finite element methods in design engineering.	CO1
2	To understand the numerical methods involved in Finite Element Theory	CO2
3	To understand direct and formal (basic energy and weighted residual) methods for deriving finite element equations.	CO3
4	To understand the role and significance of shape functions in finite element formulations and use linear, quadratic, and cubic shape functions for interpolation.	CO4
5	To design and analyse the complicated systems.	CO5

Unit-I

Fundamental Concepts: Introduction to Finite Difference Method and Finite Element Method, Applications and advantages of FEM, Commercial FEM packages, Stresses and equilibrium, Boundary conditions, Strain-displacement relations, Stress-strain relations, Potential energy approach to derive spring element equations, Rayleigh-Ritz Method, Galerkin's Method.

Unit-II

One-Dimensional Problems: Introduction, Finite element Modeling, Natural Co-ordinate system, Shape Functions, Potential energy approach, The Galerkin Approach, Element and global stiffness matrix, Assembly of Global stiffness matrix and load vector, Finite element equations: Treatment of boundary conditions, Quadratic shape functions, Temperature effects.

Unit-III

Two-Dimensional Problems: Introduction, finite element modeling, constant strain triangle (CST), Problem modeling and boundary conditions.

Axisymmetric Solids Subjected to Axisymmetric Loading: Introduction, Axisymmetric formulation, finite element modeling: Triangular elements, Problem modeling and boundary conditions.

Unit-IV

Trusses: Introduction, plane trusses, three dimensional trusses, assembly of global stiffness matrix for the banded and skyline solution.

Beams and Frames: Introduction, finite element formulation, load vector, boundary considerations, shear force and bending moment, plane frames.

Unit-V

Two -Dimensional Isoparametric Elements: Introduction, The four-node quadrilateral, Numerical Integration, Higher order elements.

FEM in Fluid Flow & Heat Transfer: 1-D Steady heat conduction, 1-D heat conduction in thin fins, and fluid flow problems.

References:

1. Introduction to Finite Elements in Engineering by T. R. Chandrupatla and A. D. Belegundu, Pearson Eduction.
2. Finite Element Methods: Basic concepts and applications by Chennakesava R. Alavala, PHI publications.
3. A First Course in Finite Element Method by Daryl L. Logan, Cengage Publication.
4. Finite Element Analysis by C.S. Krishnamurthy Tata McGraw Hill
5. Concepts and Application of Finite Element Analysis by R.D. Cook, D.S. Malcus and M.E. Plesha John Wiley
6. The Finite Element Method by O.C. Zienkiewicz and R.L. Taylor, McGraw Hill
7. Finite Element and Approximation by O.C. Zenkiewicy & Morgan
8. An Introduction to Finite Element Method by J. N. Reddy, McGraw Hill
9. Finite Element Procedure in Engineering Analysis by K.J. Bathe, McGraw Hill

MECHATRONICS

EME-477

Course Outcomes (CO)		
1	Able to develop a simulation model for simple physical systems and explain mechatronics design process.	CO1
2	Outline appropriate sensors and actuators for an engineering application.	CO2
3	Able to write simple microcontroller programs.	CO3
4	To explain linearization of nonlinear systems and elements of data acquisition.	CO4
5	To explain various applications of design of mechatronic systems.	CO5

Unit-I

Review of Microprocessors and Micro Controllers: Concepts, Binary numbers to hexadecimal details, information on flipflops, gates, registers, counters, memory, polling and interrupts etc. Architecture, instruction set for 8085, 8051 and assembly level language. Difference between microprocessors and micro controllers. Introduction to programming. Signal and Data Processing: Concepts and principles, analogue signal conditioning, signal level changes, linearization, conversion, filtering. Impedance matching passive circuits. Specifications and circuits in instrumentation. Digital signal conditioning.

Unit-II

Ladder Diagram Fundamentals:Basic Components and their symbols, Fundamentals of ladder diagrams, Machine Control Terminology. The Programmable Logic Controller : A Brief History, PLC configurations, System Block Diagrams, Update Solve the ladder – Update, Update, Solve the Ladder

Unit-III

Fundamentals of PLC Programming: Physical Components Vs Program, components, Lighting Control Example, Internal Relays, Disagreement Circuit, Majority Circuit, Oscillator, Holding contacts, Always ON and Always OFF Contacts, Ladder Diagram Having more than one rung. Programming On/Off Inputs, to produce on – off outputs : Introduction, PLC input instructions, outputs : Coils, Indicators and others, Operational procedures, Contact and Coil Input output programming Examples, Fail Safe Circuits, Industrial Process Examples.

Unit-IV

Creating Ladder Diagrams from Process Control Descriptions:Introductions, Ladder Diagrams, Sequence Listings. Large Process Ladder diagram Constructions, Flowcharting as programming Method. Introduction to Robotics: Elementary treatment on anatomy, drives, transmission and end effectors of Robotics.

Unit-V

Material Handling: Generations Considerations, Applications in material transfer and loading unloading Assembly and Inspections : Assembly and robot assembly automations, Parts presentations methods. Assembly operations, Assembly system configurations inspection automation. Introduction to Nano-technology.

Reference:

1. Programmable Logic Controller – Principles and Applications" 5/e, J. W. Webb, R. A. Reis; Prentice Hall of India Ltd. ISBN 81-203-2308-4
2. Industrial Robotics – Technology, Programming and Applications"; M. P. Groover, M. Weiss, R. N. Nagel, N. G. Ordey; McGraw Hill International Editions, Industrial Engineering Series, ISBN 0-0-100442-4
3. Programmable Logic Controller – Programming methods and Applications" Hackworth JohnR. And Hackworth Frederick D. Jr.; Pearson Education LCE, ISBN 81-297-0340-8.
4. Introduction to 8085 – Gaonkar

ADVANCE OPERATION RESEARCH

EME-478

Course Outcomes (CO)		
1	Able to identify and develop operational research models from the verbal description of the real system.	CO1
2	Able to understand the mathematical tools that are needed to solve optimisation problems.	CO2
3	Able to set up decision models and use some solution methods for nonlinear optimization problems and to show the Kuhn-Tucker optimality conditions.	CO3
4	Able to construct linear integer programming models and discuss the solution techniques.	CO4
5	Able to propose the best strategy using decision making methods under uncertainty and to solve multi-level decision problems using dynamic programming method.	CO5

Unit-I

Introduction to OR: History, Definition, OR Models, OR Techniques and phases of implementing OR in practice.

Advance Topics in Linear Programming: Duality theory, Dual Simplex method, Revised simplex method, Sensitivity analysis.

Unit-II

Nonlinear programming: Kuhn- Tucker conditions- quadratic programming- Wolfe's algorithm.

Integer programming: Graphical representation. Gomory's cutting plane method, Solving Zero-One Problems, Branch and Bond Algorithm For Integer Programming, Travelling salesman problem, Cargo loading problem, Mixed Integer Linear Programming.

Unit-III

Dynamic Programming: Deterministic and stochastic example.

Goal Programming: Formulations Goal Programming Solutions Complexity of Simplex Algorithm.

Unit-IV

Decision Theory: Introduction, Decision under certainty, Decision under risk, Decision under uncertainty: Laplace criterion, MaxiMin criterion, MiniMax criterion, savage MiniMax regret criterion, hurwicz criterion, Decision tree.

Unit-V

Special topics: Analytic Hierarchy Process for Decision Making, Extreme Difference Method, Multi-objective Transportation Problem.

Reference:

1. Wagner H. M., Principles of Operation Research with Applications to Managerial Decisions, 2nd Ed., PHI, 2010.
2. Taha H. A., Operation Research, 7th Ed., *Prentice Hall of India*, New Delhi, 2002.
3. Vohra N.D, Quantitative Techniques in Management, Tata McGraw Hill, 1995.
4. Sharma J. K., Operation Research Theory and Applications, 2nd Ed., Macmillan, 2003.
5. Hira D. S. &Gupt P. K., Operations Research, S. Chand & Co. 1995.
6. Kasana H. S., Kumar K. D., Introductory Operations Research Theory and Applications, Springer, 2003.
7. Wilkes F. M., Elements of Operational Research, McGraw Hill Co.
8. Levin R. et.al, Quantitative approaches to mgmt, McGraw Hill Co.
9. Hiller & Lieberman, Introduction to Operations Research
10. Richard Broson, Govindasamy&Naachimuthu, Schaum's Outline of Theory and Problems of Operations Research, II Edition, Tata McGraw Hill , 2004.
11. En R. P., Operations Research Algorithm and Applications, PHI, New Delhi.
12. Shah N. H., Gor R. M., Soni H., Operations Research, PHI, New Delhi, 2007.

OPERATIONS MANAGEMENT

EPE-476

Course Outcomes (CO)		
1	Able to define 'operations' and 'operations management'	CO1
2	Able to identify the roles and responsibilities of operations managers in different organisational contexts	CO2
3	Able to apply the 'transformation model' to identify the inputs, transformation processes and outputs of an organisation	CO3
4	Able to identify operational and administrative processes	CO4
5	Able to describe the boundaries of an operations system, and recognise its interfaces with other functional areas within the organisation and with its external environment.	CO5

Unit-I

Introduction: Basic concepts of operations and production management, types of manufacturing systems and their characteristics.

Product and Process Design: System planning and design, long-range planning, product and process design and technological considerations.

Unit-II

Demand Forecasting: Role of demand forecasting in operations decisions; various demand patterns, qualitative and quantitative techniques of demand forecasting.

Unit-III

Production Planning and Scheduling: Aggregate production planning, operation scheduling, various scheduling criteria, lot sizing, job shop control; Mutli-stage manufacturing systems, their scheduling and management, capacity planning.

Unit-IV

Materials Planning: Details of material requirement planning (MRP) and manufacturing resource planning (MRP-II) and their various techniques.

Unit-V

Facilities Planning: Plant design, types and considerations in the plant location, plant layout types, design, evaluation, principles and types of material flow, optimum plant layout.

References:

1. Buffa, E. S. and Sarin, R. K., "Modern Production/Operations Management", 8th Ed., John Wiley & Sons.
2. Adam, E., Jr. and Ebert, R. E., "Production Operations Management", 5th Ed., Pearson Education.
3. Brown, S., Blackmon, K., Cousins, P. and Maylor H., "Operations Management: Policy, Practice, and Performance Improvement", Butterworth-Heinemann.
4. Dervitsiotis, K. N., "Operations Management", 2nd Ed., McGraw Hill.
5. Starr M. K., "Production and Operations Management", Thomson Business Information.
6. Karjewski, L. J, Ritzman, L. P. and Malhotra, M. K., "Operations Management: Processes & Supply Chains, 9th Ed., Pearson Education.

TOTAL QUALITY MANAGEMENT

EPE-478

Course Outcomes (CO)		
1	Knowledge and understanding of the philosophies which have enabled the development of organizational quality improvement programmes, use of control chart for quality assessment and some parameters of quality management such as quality in design, quality in manufacturing and quality in procurement.	CO1
2	Recognize the contributions of world's leading experts on quality management and through this, develop the intellectual skills.	CO2
3	To Understand the importance of process knowledge and process control and understand how staff, customers and stakeholders are part of the success of an organization.	CO3
4	To Understand the scope of quality management be aware of the need to think differently in an organization and develop a glossary of items which relate to the concepts of quality	CO4
5	To Understand the importance of communication in key decision making which are related with the continuous process improvement in quality and in process	CO5

Unit-I

Quality Concepts: Evolution of Quality control, concept change, TQM Modern concept, Quality concept in design, Review off design, Evolution of proto type. Control on Purchased Product Procurement of various products, evaluation of supplies, capacity verification, Development of sources, procurement procedure. Manufacturing Quality Methods and Techniques for manufacture, Inspection and control of product, Quality in sales and services, Guarantee, analysis of claims.

Unit-II

Quality Management: Organization structure and design, Quality function, decentralization, Designing and fitting organization for different types products and company, Economics of quality value and contribution, Quality cost, optimizing quality cost, seduction programme. Human Factor in Quality Attitude of top management, co-operation, of groups, operators attitude, responsibility, causes of operators error and corrective methods.

Unit-III

Control Charts: Theory of control charts, measurement range, construction and analysis of R charts, process capability study, use of control charts. Attributes of Control Charts Defects, construction and analysis off-chart, improvement by control chart, variable sample size, construction and analysis of C chart.

Unit-IV

Defects Diagnosis and Prevention Defect study, identification and analysis of defects, corrective measure, factors affecting reliability, MTTF, calculation of reliability, Building reliability in the product, evaluation of reliability, interpretation of test results, reliability control, maintainability, zero defects, quality circle.

Unit-V

IS0-9000 and its concept of Quality Management, ISO 9000 series, Taguchi method, JIT in some details.

References:

1. Lt. Gen. H.Lal, "Total Quality management", Wiley Eastern Limited, 1990. .
2. Greg Bounds. "Beyond Total Quality Management".McGraw Hill, 1994.
3. Menon, H.G, "TQM in New Product manufacturing", McGraw Hill 1992.

CAD/CAM Lab

PME-471

Course Outcomes (CO)		
1	Able to develop solutions of the problems of mechanical design and manufacturing by the help of computer programming.	CO1
2	Able to understand and capability for applying software skills in design and manufacturing.	CO2
3	Review and document the knowledge developed previously and critically assess the relevant technological issues.	CO3
4	Formulate and do analytical study with modern scientific methods by using software tools.	CO4
5	Able to Design and validate technological solutions to problems and communicate clearly for the practical application of their work.	CO5

A minimum of 08 experiments from the following (minimum 04 from each):

A. CAD Experiments

1. Line Drawing or Circle Drawing experiment: Writing and designing steps.
2. Design of machine component or other system experiment: Writing and designing steps.
3. Understanding and use of any 3-D Modeling Software commands.
4. Pro-E, Ideas, CATIA, ANSYS etc. Experiment: Solid modeling of a machine component.
5. Understanding the commands and specific usages in CAD.

B. CAM Experiments

1. To study the characteristic features of CNC machine.
2. Experiment on Robot and programs.
3. Experiment on Transfer line/Material handling.
4. Experiment on difference between ordinary and NC machine, study on Mechatronics and controls.
5. Experiment on study of system devices such as motors and feedback devices.

* *Additional or any other experiment may be added based on contents of syllabi.

COURSES AND EVALUATION SCHEME

YEAR IV, SEMESTER VIII

(B. Tech. Mechanical Engineering)

S. No.	COURSE CODE	SUBJECT	PERIODS			EVALUATION SCHEME				
						SESSIONAL EXAM			ESE	Subject Total
			L	T	P	CT	TA	Total		
A) THEORY										
1.	TME-481	Automobile Engineering	3	1	0	30	20	50	100	150
2.	TME-482	Power Plant Engineering	3	1	0	30	20	50	100	150
3.	EME-48X	Elective III	3	1	0	30	20	50	100	150
4.	EME-48X	Elective IV	3	1	0	30	20	50	100	150
B) PRACTICAL										
5.	PME-481	Automobile Lab	0	0	2	10	15	25	25	50
6.	PME-483	Project(II)	0	0	2	0	100	100	200	300
7.	GPP-481	General Proficiency (NSS/NCC/Sports/Cultural)	-	-	-	-	50	50	-	50
SEMESTER TOTAL			**12**	**4**	**4**	**130**	**245**	**375**	**625**	**1000**

List of Electives

Elective-III

1. EME-481 Experimental stress analysis
2. EME-482 Machine Tool Design
3. EME-483 Robotics and automation
4. EME-484 Thermal Turbo Machines
5. EME-486 Renewable Energy System
6. EPE-482 Supply Chain Management

Elective-IV

1. EME-485 Energy Efficient Buildings
2. EME-487 Modelling and Simulation
3. EME-488 CFD and Heat Transfer
4. TPE-481 Unconventional Manufacturing Processes
5. EPE-485 Composite Materials
6. EPE-488 Industrial Tribology

AUTOMOBILE ENGINEERING

TME-481

Course Outcomes (CO)		
1	Able to classify the different types of automobile and its parts, description and performance of an automobile and fuel supply system in S.I. and C.I. engine.	CO1
2	Able to Define the role of engine friction, engine cooling and lubrication system in automobile.	CO2
3	Able to Explain classification and working of chasis, frame, wheels and tyres.	CO3
4	Able to Classify and describe the working of steering, braking, suspension and transmission system of automobile.	CO4
5	Able to Understand the working of automotive electrical system, starting system, ignition system, charging system, lighting and maintenance system of an automobile.	CO5
6	Able to Develop a strong base for understanding future developments in the automobile industry.	CO6

Unit-I

Introduction: Classification of automobile, Parts of an automobile, Description of an automobile, performance of automobile, engine cycle-energy balance, terms connected with I.C. Engines, Detonation, performance number, attractive efforts.

Fuel-Supply System:

S.I. Engine: Carburetion & carburettors, Induction system, factor influencing carburetion, Mixture requirement, Distribution, Complete carburettor, theory of simple carburettor.

C.I. Engine: Functional requirements of an injection system, Fuel pump and fuel injector (Atomizer), Types of nozzles and fuel spray patterns, troubleshooting of a fuel system & carburettor, Turbo Charger (Function and benefits).

Unit-II

Engine Friction, Lubrication & Cooling System: Determination of engine friction, Lubrication, lubrication system, Crankcase ventilation, Necessity of engine cooling, Areas of heat flow in engines, gas temperature variation, heat transfer, temperature distribution & temp. Profiles, cooling air and water requirements, cooling systems, troubleshooting of cooling system, gear box (Problems).

Unit-III

Chassis: Introduction. Classification of chassis, Frame.

Suspension: Introduction, requirements of suspension system, springs, damper.

Wheels: Introduction, Requirement, types of wheels.

Tyres: Introduction, requirements, types of tyre, tyre construction-cross ply, radial ply, belted bias, tyre materials tyre shape, tread patterns, tyre markings, tyre inflation pressure, causes of wear, factors affecting tyre life, wheel balancing, wheel alignments.

Unit-IV

Steering and Gears: Purpose, function, requirements, general arrangements of steering systems, steering gears, steering ratio, reversibility, steering geometry, under steering, over steering, steering arms, Drag link, power steering, adjusting of steering geometry, steering troubleshooting. Requirements. Clutches. Toque converters. Over drive and free wheel, Universal joint. Differential Gear Mechanism of Rear Axle. Automatic transmission, Steering and Front Axle. Castor Angle.

Front Axle: Introduction, construction, types of front axles, stub axles.

Braking System: Necessity, functions, requirements, classification of brakes, Mechanical brakes, hydraulics brakes, power brakes, brake effectiveness, brake shoe holding down arrangements, brake tester, brake service, troubleshooting chart of hydraulic brakes system, air brakes & Brake shoes & drums.

Unit-V

Automotive Electrical System: Introduction, main parts of vehicles.

Starting System: Introduction, battery, starting motor.

Ignition System: Introduction, purpose, requirements, coil ignition system, firing order, ignition timing, spark plugs, troubleshooting.

Charching System: Introduction. Dynamo, alternators.

Lighting: Introduction, main circuits, lighting system.

Maintenance system: Preventive maintenance, break down maintenance, and over hauling system.

References:

1. Automotive Engineering- Hietner
2. Automobile Engineering - Kripal Singh.
3. Automobile Engineering - Narang.
4. Automotive Mechanics- Crouse
5. Automobile Engg. – K.N.Gupta

POWER PLANT ENGINEERING

TME-482

Course Outcomes (CO)		
1	To familiarize students with various sources of energy that can be used for power generation and air requirement for burning of fuel on basis of analysis of flue gases.	CO1
2	To have knowledge of the various components employed in a steam power plant including boilers, ash handling equipment's, burners, methods of feed water treatment etc.	CO2
3	To introduce diesel engine components and list advantages of combined cycle power plants.	CO3
4	To understand the basic principle on which hydraulic power plants are based and understand favourable conditions for employment of such plants	CO4
5	To understand the nuclear reactor and its essential components	CO5

Unit-I

Introduction: Power and energy, sources of energy, review of thermodynamic cycles related to power plants, fuels and combustion, calculations. Variable Load problem Industrial production and power generation compared, ideal and realised load curves, terms and factors. Effect of variable load on power plant operation, methods of meeting the variable load problem. Power plant economics and selection Effect of plant type on costs, rates, fixed elements, energy elements, customer elements and investor's profit, depreciation and replacement, theory of rates. Economics of plant selection, other considerations in plant selection.

Unit-II

Steam power plant: Power plant boilers including critical and super critical boilers. Fluidized bed boilers, boilers mountings and accessories. General layout of steam power plant. Different systems such as fuel handling system, pulverizes and coal burners, combustion system, draft, ash handling system, feed water treatment and condenser and cooling system, turbine auxiliary systems such as governing, feed heating, reheating , flange heating and gland leakage. Operation and maintenance of steam power plant, heat balance and efficiency**.**

Unit-III

Diesel power plant: General layout, performance of diesel engine, fuel system, lubrication system, air intake and admission system, supercharging system, exhaust system, diesel plant operation and efficiency, heat balance. Gas turbine power plant Elements of gas turbine power plants, Gas turbine fuels, cogeneration, auxiliary systems such as fuel, controls and lubrication, operation and maintenance, Combined cycle power plants.

Unit-IV

Hydro electric station: Principles of working, applications, site selection, classification and arrangements, hydroelectric plants, run off size of plant and choice of Units, operation and maintenance, hydro steam interconnected systems, micro and mini hydro power plant.

Unit-V

Nuclear power plant: Principles of nuclear energy, basic components of nuclear reactions, nuclear power station. Nuclear fuels in fission and fusion reactors, Types of nuclear reactors, Fissile and fertile materials, Neutron chain reaction in fission reactors, Neutron flux, Concept of criticality for bare homogeneous reactors, Coolants, moderators, Control and structural materials. Heat generations and steady state temperature distribution in fuel elements, Heat removal.

References:

1. Nuclear Reactor Engineering By S. Glastone and A . Sesonske.

2. Basic Nuclear Engineering, by K.S. Ram.
3. Introduction to Nuclear Engineering, by J.R lamarsh.
4. “Power Plant Engineering” F.T. Morse, Affiliated East-West Press Pvt. Ltd, New Delhi/Madras.
5. “Power Plant Engineering” Mahesh Verma, Metropolitan Book Company Pvt. Ltd. New Delhi.
6. “Power Plant Technology” El-Vakil, McGraw Hill.
7. Power Plant Engineering by P.K. Nag, Tata McGraw Hill.
8. Steam & Gas Turbines & Power Plant Engineering by R.Yadav, Central Pub.House.

EXPERIMENTAL STRESS ANALYSIS

EME- 481

Course Outcomes (CO)		
1	Will demonstrate a basic understanding of experimental methods (e.g. strain gages, photoelasticity, image correlation) commonly used in experimental solid mechanics.	CO1
2	Will demonstrate the ability to complete a detailed laboratory report and present their findings in a structured, logical manner.	CO2
3	Will demonstrate the ability to apply knowledge learned in previous classes.	CO3
4	Will demonstrate the ability to analyse experimental data.	CO4
5	Will demonstrate the ability to develop appropriate, logical conclusions based on comparisons to theoretical results and other experimental evidence.	CO5

Unit-I

Elementary Elasticity: Stress: Introduction, Stress Equations of Equilibrium, Laws of Stress Transformations, principal Stresses, Two-Dimensional State of Stress, Stresses Relative to Principal Co-ordinate System, Special States of Stress. Strain: Introduction, Displacement and Strain, Strain Transformation Equation, Principal Strains, Compatibility, Volume Dilation, Stress Strain Relations, Strain Transformation Equations and Stress Strain Relations for Two-Dimensional State of Stress.

Unit-II

Strain Measurements: Introduction, Properties of Strain Gage Systems, Types of Strain Gages, Grid-Method of Strain Analysis. Brittle Coating Method: Coating Stresses, Failure Theories, Brittle Coating Crack Patterns, Resin and Ceramic Based Brittle Coating, Test Procedure, Analysis of Brittle Coating Data.

Unit-III

Electrical Resistance Strain Gages: Introduction, Strain Sensitivity in Alloys, Strain Gage Adhesives, Gage Sensitivity and Gage Factor. Strain Gage Circuit: Potentiometer and its Application, Wheat-Stone Bridge, Bridge Sensitivity, Null Balance Bridges. Analysis of Strain Gage Data: Three Element Rectangular Rosette, Delta Rosette, Stress Gage, Plane Shear-Gage.

Unit-IV

Theory of Photoelasticity: Introduction, Temporary Double Refraction, Stress Optic Law, Relative Retardation, Stressed Model in Plane Polariscope, Effect of Principal Directions, Effect of Principal Stress Difference, Stressed Model in Circular Polariscope, Light and Dark Field arrangements, Tardy Compensation, Fringe Sharpening and Multiplication by Partial Mirrors.

Unit-V

Two Dimensional Photoelasticity : Introduction, Isochromatic Fringe Patterns, Isoclinic Fringe Patterns, Compensation Techniques, Calibration Methods, Separation Methods, Shear Difference Method, Electrical Analogy Method, Oblique Incidence Method, Materials for Two-dimensional Photo elasticity.

References:

1. Experiment Stress Analysis by James W. Dally and William F. Riley, International Student Edition, McGraw-Hill Book Company.
2. Experiment Stress Analysis by Dr. Sadhu Singh, Khanna Publishers.

MACHINE TOOL DESIGN

EME-482

Course Outcomes (CO)		
1	Able to Explain auxiliary and feed motion in different machine tools, know the general requirements of machine tools, basic cutting operation and mathematical calculation of cutting processes.	CO1
2	Able to Know the working of different drives used in machine tools to provide rotary and translator motion.	CO2
3	Able to Design the speed box and feed box for speed regulation, construct structure diagram and ray diagrams for gear box.	CO3
4	Able to Apply the design procedures, Model technique on different types of machine tool structures and/or machine tool components like machine tool bed, column, guideways, spindles etc.	CO4
5	Able to Know the factors that affect the static as well as dynamic stability of machine tool structures, Asses the dynamic stability of EES and dynamic characteristics of cutting process, stability analysis.	CO5

Unit-I

Introduction: Developments is machine tools, types of machine tools surface, profits and paths produced by machine tools. Features of construction and operations of basic machine tools e.g. lathe, drill, milling shapes and planers, grinding machine etc. General requirement of machine tool design. Machine tool design process. Tool wear, force Analysis.

Unit-II

Machine Tools Drives: Classification of machine tool drives, group Vs individual drives, Selection of electric motor, A brief review of the elements of mechanical transmission e.g. gear, belt and chain drives, slider-crank mechanism, cam mechanism, nut & Screw transmission, Devices for intermittent motion, reversing & differential mechanisms. Couplings and clutches Elements of hydraulic transmission system. e.g. pumps, cylinder, directional control valves, pressure valves etc. Fundamentals of Kinematics structure of machine tools.

Unit-III

Regulation of Speed and Feed rates: Laws of stepped regulation, selection of range ratio, standard progression ratio, selection of best possible structural diagram, speed chart, Design of feed box, Developing gearing diagrams. Stepless regulation of speed and feed in machine tool, speed and feed control.

Unit-IV

Design of Machine Tool Structure: Requirements and design criteria for machine tool structures, selection of material Basic design procedure for machine tool structures, design of bed, column and housing, Model technique in design. Design of guide ways and power screws: Basic guide way profiles, Designing guide way for stiffness a wear resistance, hydrostatic and antifriction grand ways. Design of sliding friction power Screws. Design of spindlier & spindle supports. Layout of bearings, selection of bearings for machine tools.

Unit-V

Dynamics of machine tools: General procedure for assessing the dynamic stability of cutting process, closed loop system, chatter in machine tools.Control Systems : Functions, requirements & types of machine tool controls, controls for speed & feed change. Automatic and manual Controls. Basics of numerical controls. Machine tool testing.

References:

1. Machine Tools Design & Numerical Controls –N.K. Mehta, T.M.H. New Delhi.

2. Design of Machine Tools – S.K. Basu Allied Publishers.
3. Principles of Machine Tools, Bhattacharya A and Sen.G.C. New Central Book Agency.

ROBOTICS AND AUTOMATION

EME- 483

Course Outcomes (CO)		
1	Will demonstrate knowledge of the relationship between mechanical structures of industrial robots and their operational workspace characteristics.	CO1
2	Will demonstrate an ability to apply spatial transformation to obtain forward kinematics equation of robot manipulators.	CO2
3	Will demonstrate an ability to solve inverse kinematics of simple robot manipulators.	CO3
4	Able to apply localization and mapping aspects of mobile robotics.	CO4
5	Able to demonstrate self-learning capability	CO5

Unit-I

Introduction: Brief history, robot terminology, classification, characteristic, physical configuration, structure of industrial robot. Robot and Effectors: Types, mechanical grippers, other types of gripper, tools as end effectors, Robot/end effector interface, design consideration.

Robot Motion Analysis & Control: Introduction to manipulator kinematics, robot dynamics, manipulator dynamics, robot control, task planning.

Unit-II

Sensors: Transducers and sensors, sensors in robotics, tedile sensors, proximity and range sensors, miscellaneous sensors and sensor-based systems, use of sensors in robotics, touch sensors, force-torque sensors.

Machine Vision: Introduction, sensing and digitizing function in machine vision, image processing and analysis, vision system robotic applications.

Unit-III

Programming: Basics of robot programming, languages, commands, communications and data processing.

Applications: Welding, electro-plating, painting, spraying, assembling, material handling, inspection, Future applications. Introduction to design of robot in specific applications.

Unit-IV

Fundamentals of Manufacturing Automation: Basic Principles of automation, types of automated systems, degrees of automation,Automated flow lines. Automation for machining operations Design and fabrication considerations.Analysis of multi station assembly.

Automated Material Handling: components, operation, types, design of automated guided vehicles and applications.

Automated storage / retrieval systems - types, basic components and applications.

Unit-V

Group Technology: Part families, part classification and coding, machine Cell design, Benefits. Computer Aided Process Planning, benefits and limitations.

Automated Inspection and Testing: Automated inspection principles and methods sensors techniques for automated inspection-techniques for automated inspection-contact and noncontact inspection methods-in process gauging, CMM's, construction, types, inspection probes, types, and applications. Machine vision, LASER Micrometer and optical inspection methods.

References:

1. Industrial Robotics (Technology, Programming and applications) – Mc Graw Hill Editions
2. Robotics – An introduction - Douglas R. Malcolm. Jr -- Delmar Publisher Inc
3. Robot technology fundamentals - Saures G. Keramas - Delmar publishers
4. Fundamentals of robotics – analysis & control - Robert J. Schilling – (PHI) edition

THERMAL TURBO MACHINES

EME- 484

Course Outcomes (CO)		
1	Able to Explain the working principles of turbo machines and apply it to various types of machine.	CO1
2	Able to Determine the velocity triangles in turbo machinery stages operating at design and off design condition.	CO2
3	Able to Use design parameters for characterizing turbo machinery stages.	CO3
4	Able to understand the centrifugal compressor and also understand the steam turbines.	CO4
5	Able to understand the gas turbine operating conditions	CO5

Unit-I

Brief history of turbo machinery, introduction to blowers, pumps, compressors, steam & gas turbines, turbojet, Review of laws of thermodynamics & SFEE in reference to turbo machinery, Energy transfer in turbo machines, Euler's equation, Velocity diagrams for axial & radial turbo machinery and pumps. Definition of various efficiencies, Introduction to blowers, pumps, compressors, steam & gas turbines turbojet.

Unit-II

Centrifugal compressors: Principle of operation, work done and pressure rise, Diffuser, state losses, ship factors, Performance, characteristics. Axial flow compressor- basic operation, Elementary theory, Factors affecting stage pressure ratio, Blockage in compressor annulus, Degree of reaction, 3-D flow, Design process, blade design, calculation of stage performance. Supersonic & transonic stages, Performance.

Unit-III

Axial flow turbines: Elementary theory of axial flow turbine, Vortex theory, Choice of blade profile, pitch and chord, Estimation of stage performance.

Unit-IV

Steam turbines: Constructional details, working of steam turbine.

Pumps: Pumps, main components, indicator diagram and modification due to piston acceleration, performance and characteristics, axial flow pumps.

Radial flow turbines: Single velocity triangle Enthalpy- Entropy diagram, State losses, performance, Characteristics.

Unit-V

Gas Turbine Starting & Control Systems: Starting ignition system, combustion system types, safety limits & control.

Turbine Blade coding: Cooling techniques, types Mechanical Design consideration: Overall design choices, Material selection, Design with traditional materials.

References:

1. Gas turbine theory : Gohen & Rogers, Addison Weslay Longman Ltd.
2. Design of high efficiency turbomachinery and gas turbines, David Gordon Wilson, Theodosius Korakianitis, Prentice Hall International.
3. Turbomachinery : S.M. Yahya.
4. Turbine, Compressors and Fans, S.M. Yahya, Tata Mc Graw Hill.
5. Gas Turbine- Ganeshan, Tata Mc Graw HillTME 044

RENEWABLE ENERGY SYSTEM

EME-486

Course Outcomes (CO)		
1	Able to list and generally explain the main sources of energy and their primary applications in the world.	CO1
2	Able to describe the challenges and problems associated with the use of various energy sources, including fossil fuels, with regard to future supply and the environment.	CO2
3	Able to discuss remedies/potential solutions to the supply and environmental issues associated with fossil fuels and other energy resources.	CO3
4	Able to list and describe the primary renewable energy resources and technologies.	CO4
5	Able to describe/illustrate basic electrical concepts and system components.	CO5

Unit-I

Introduction: Energy and development, energy demand and availability, energy crisis, conventional and non-conventional, renewable and non-renewable energy resources, environmental impact of conventional energy usage, basic concepts of heat and fluid flow useful for energy systems.

Unit-II

Solar Energy Systems: Solar radiations data, solar energy collection, storage and utilization, solar water heating, air heating, power generation, refrigeration and air conditioning, solar energy system economics.

Unit-III

Micro and Small Hydro Energy Systems: Resource assessment of micro and small hydro power, micro, mini and small hydro power systems, economics, pump as turbine, special engines for low heads, velocity head turbines, hydrams, water mills.

Unit-IV

Biomass Energy Systems: Availability of biomass- agro, forest, animal, municipal and other residues, bioconversion technologies, cooking fuels, biogas, producer gas, power alcohol from biomass, power generation, internal combustion engine modifications and performance, system economics.

Unit-V

Ocean Energy Systems: Ocean temperature energy conversion system (OTEC), Wave energy systems, Tidal power systems.

Wind Energy Systems: Wind data, horizontal and vertical axis wind mills, wind farms, performance and economics of wind energy.

References:

1. Boyle, G. “Renewable Energy”, 2nd Ed., Oxford University Press.
2. Da Rosa, A. V. “Fundamentals of Renewable Energy Processes”, 2nd Ed., Academic Press.
3. Hodge, B. K., “Alternative Energy Systems and Applications”, John Wiley & Sons.
4. Sukhatme, S.P. and Naik, J.K., “Solar Energy”, 3rd Ed., Tata McGraw Hill.
5. Duffie, J.A. and Beckman, W.A., “Solar Engineering of Thermal Processes”, John Wiley & Sons.

SUPPLY CHAIN MANAGEMENT

EPE-482

Course Outcomes (CO)		
1	Able to apply metrics in supply chains.	CO1
2	Able to define the principles of scheduling and planning in supply chain management.	CO2
3	Able to apply the principles of Strategic/Master planning of resource in supply chains.	CO3
4	Able to identify the principles of customer and supplier relationship management in supply chains	CO4
5	Able to define the principles of quality and lean manufacturing	CO5

Unit-I

Introduction: Understanding supply chain, supply chain performance; supply chain drivers and obstacles.

Unit-II

Planning Demand and Supply in a Supply Chain: Demand forecasting in supply chain, aggregate planning in supply chain, planning supply and demand; managing predictable variability, Economic Order Quantity Models, Reorder Point Models, Multi-echelon Inventory Systems.

Unit-III

Planning and Managing inventories in a Supply Chain: Managing economies of supply chain, managing uncertainty in a supply chain, determining optimal levels of product availability.

Unit-IV

Transportation, Network Design and Information Technology: Transportation aspects in a supply chain, facility Decision, Network design in a supply chain, Information technology and its use in supply chain.

Unit-V

Coordination in Supply Chain and effect of E- Business: Role of Coordination and E-business in a supply chain; financial evaluation in a supply chain.

References:

1. Hopp W. J., Spearman M. L. and Irwin, "Factory Physics: Foundations of Manufacturing", McGraw-Hill Inc. New York.
2. Sridhar Tayur, Ram Ganeshan and Michael Magazine (editors), "Quantitative Models for Supply Chain Management", Kluwer Academic Publishers, UK.
3. Handfield R.B. and Nochols E.L.Jr., "Introduction to Supply Chain Management", Prentice Hall Inc. Englewood- Cliff, New Jersey.
4. Viswanadham N. and Narahari Y., "Performance Modeling of Automated Manufacturing Systems", Prentice Hall of India, New Delhi.
5. Viswanadham N., "Analysis of Manufacturing Enterprises", Kluwer Academic Publishers, UK.
6. Chopra S. and Meindel P., "Supply Chain Management: Strategy, Planning, and Operation", Prentice Hall of India, New Delhi.
7. Shapiro J. F., Duxbury Thomson Learning, "Modeling the Supply Chain", Duxbury Thomson Learning Inc., Duxbury, Pacific Grove.
8. Levi D. S., Kaminsky P. and Levi E. S., "Designing and Managing the Supply Chain: Concepts, Strategies, and Case Studies", McGraw Hill Inc. New York.

ENERGY EFFICIENT BUILDINGS

EME-485

Course Outcomes (CO)		
1	Able to Create resource-efficient structures that are comfortable and healthy.	CO1
2	Able to Identify issues of energy management, light, temperature, air quality and psychological aspects of structures that affect health.	CO2
3	Able to Apply empirical equations suggested by ASHRAE of buildings to perform energy calculations, evaluate the relationship between energy use, indoor comfort and users.	CO3
4	Able to calculate heat transmission in different building structures like residential, commercial, industrial etc.	CO4
5	Able to get Adequate knowledge of the physical problems and technologies and of the function of buildings so as to provide them with internal conditions of comfort and protection against the climate.	CO5

Unit-I

Energy Efficient Building Design Strategies: Energy use in Buildings, Factors effecting Energy use, Energy Conservation options. External Factors – Climate, Building Orientation, Shading, types of shading devices.

Unit-II

Thermal Comfort: Criteria and various Parameters, Psychometric Chart, Thermal Indices. Indoor air quality, Requirements in residential, Commercial, Hospital Buildings.

Unit-III

Passive concepts and components:

(a) Passive heating concepts: direct gain, indirect gain, isolated gains and suspenses;
(b) Passive cooling concepts: evaporative cooling, evaporative air and water coolers, radiative cooling, application of wind, water and earth for cooling ,use of isolation, shading, paints and cavity walls for cooling;
(c) Passive heating and cooling concepts: roof pond/sky therm, roof radiation trap, vary-therm wall, earth sheltered or earth based structures and earth airtunnels; selective ventilation, components-windows and thermal storage

Unit-IV

Heat Transmission in Buildings: Surface Coefficient, Air cavity, Internal and External Surface, Overall Thermal Transmittance Walls and Windows, and Packed Roofthached Heat Transfer due to ventilation/ infiltration, Building loss coefficient Internal Heat gains, Solar Temperature, Steady State Method (for Trombe Wall, Water wall and Solarium), Degree Day method. Correlation methods - solar load ratio, load collector ratio, thermal time constant method, Analytical methods - thermal circuit analysis, admittance procedure of metrics.

Unit-V

The periodic solutions: thermal modeling of AC / Non AC buildings. Typical Designs of Selected Buildings in various Climatic Zones, Thumb Rules for Design of Building systems and Building Codes.

References:

1. M.S.Sodha, N.K. Banaal, P.K.Bansal, A.Rumaar and M.A.S. Malik, Solar Passive: Building Science and Design, Pergamon Preen (1986).
2. Jamee; L. Threlked, Thermal Environment Engineering, Prentice Hall, INC-, Raglevood Cliffs, New Jersey (1970)

3. T.A. Markus and R.N. Morris, Building, Climate and Energy Spottwoode Ballantype Ltd-, London U.K. (1980)
4. Solar Thermal Energy Storage, H. P. Garg et.al, D. Reidel Publishing Company (1985)
5. Mathematical Modeling of Melting and Freezing Process, V Alexiades & A.D. Solomon, Hemisphere Publishing Corporation, Washington (1993)
6. Energy storage technologies, a reading material prepared by Dr. D. Buddhi, School Of Energy And Environmental Studies, DAVV, Indore.

MODELING AND SIMULATION

EME-487

Course Outcomes (CO)		
1	Able to define basic concepts in modeling and simulation (M&S) and to classify various simulation models and give practical examples for each category.	CO1
2	Able to construct a model for a given set of data and motivate its validity	CO2
3	Able to generate and test random number variates and apply them to develop simulation models	CO3
4	Able to analyze output data produced by a model and test validity of the model	CO4
5	Able to explain parallel and distributed simulation methods	CO5

Unit-I

Introduction to Modeling: Concept of system, continuous and discrete systems; Types of models and simulation; Discrete event simulation: Time advance mechanisms, components and organization of simulation model, steps in simulation study.

Unit-II

Statistical Models in Simulation: Discrete, continuous, Poisson and empirical distributions, output data analysis for a single system, comparing alternative system configurations, statistical procedures for comparing real world observations with simulation output data, generation of arriving processes, verification and validation of simulation models.

Unit-III

Stochastic Simulation: Random number generation: Properties of random numbers, techniques of generating random numbers, generation of random variates, Monte Carlo simulation and its applications in queuing models and inventory models.

Unit-IV

Simulation of Manufacturing and Material Handling Systems: Models of manufacturing systems, models of material handling systems, goals and performance measures; Issues in manufacturing and material handling simulation: Modeling downtime failures, trace driven models.

Unit-V

Case Studies on Simulation Packages: Simulation of queuing system (bank/job shop), simulation of manufacturing and material handling systems.

References:

1. Banks, J., Nelson, B.L., Carson, J. S., and Nicol, D., "Discrete Event System Simulation", Pearson Education
2. Law, A.M., and Kelton, W.D., "Simulation Modeling and Analysis", McGraw-Hill
3. Schwarzenbach, J., and Gill, K.F., "System Modeling and Control", Butterworth-Heinemann
4. Carrie, A., "Simulation of Manufacturing Systems", John Wiley & Sons
5. Viswanadham, N., and Narahari, Y., "Performance Modeling of Automated Manufacturing System", Prentice-Hall of India

CFD AND HEAT TRANSFER

EME-488

Course Outcomes (CO)		
1	Able to analyse mathematical and computational methods for fluid flow and heat transfer simulations.	CO1
2	Able to solve computational problems related to fluid flows and heat transfer.	CO2
3	Able to evaluate the grid sensitivity and analyze the accuracy of a numerical solution.	CO3
4	Able to Evaluate flow parameters in internal and external flows.	CO4
5	Able to use Finite Difference and Finite Volume methods in CFD modeling	CO5

Unit-I

Introduction: Conservation equations: Mass, Momentum and Energy equations, Conservative forms of the equations and general description.

Unit-II

Classification and Overview of Numerical Methods: Classification into various types of equation: Parabolic, Elliptic and Hyperbolic, Boundary and initial conditions, Overview of numerical methods.

Unit-III

Finite difference method: Introduction, Finite difference approximations, Taylor series expansion, polynomial fitting, approximation of boundary conditions, applications to conduction and advection-diffusion problems.

Finite volume method: Basic methodology, finite volume discretization, approximation of surface and volume integrals, interpolation methods- Central, upwind and hybrid formulations and comparison for convection-diffusion problem.

Unit-IV

Methods of Solution: Solution of finite difference equations, iterative methods, matrix inversion methods, ADI method, operator splitting, fast fourier transform, applications.

Numerical Grid Generation: Basic ideas, Transformation and mapping, unstructured grid generation.

Unit-V

Finite Element Method: Introduction to Rayleigh-Ritz , Galerkin and least square methods, interpolation functions, one or two dimensional elements, applications and advantages of FEM.

References:

1. Anderson. D. A., Tannehill, J. C. And Pletcher, R. H., "Computational Fluid Mechanics and Heat Transfer", Taylor and Francis.
2. Anderson, J. D., Jr., "Computational Fluid Dynamics", Mc-Graw Hill.
3. Ferziger, J. H. and Peric, M., "Computational Methods for fluid Dynamics", 3rd Ed., Springer.
4. Versteeg, H. and Malalasekra, M., "An introduction to Computational Fluid Dynamics: The Finite Volume Method", 2nd Ed., Prientice Hall.
5. Introduction to Finite Elements in Engineering by T.R Chandrupatla and A.D. Belegundu, Prentice Hall India
6. Finite Element Procedure in Engineering Analysis by K.J. Bathe, McGraw Hill
7. Finite Element Analysis by C.S. Krishnamurthy Tata McGraw Hill
8. Numerical Methods in Heat Transfer & Fluid Flow S.V.Patankar.
9. An Introduction to Finite Element Method by J. N. Reddy, McGraw Hill.

UNCONVENTIONAL MANUFACTURING PROCESSES

TPE-481

Course Outcomes (CO)		
1	Able to understand as well as demonstrate the knowledge and the basic techniques of manufacturing processes.	CO1
2	Able to select any better unconventional method for machine harder material in comparison to regular cutting processes	CO2
3	Able to understand the applications of various modern machining methods of thermal action.	CO3
4	Able to understand the various modern methods of joining two materials.	CO4
5	Able to understand the importance and criteria to apply an unconventional process for forming of different materials	CO5

Unit-I

Introduction: Limitations of conventional manufacturing processes, need of unconventional manufacturing processes and its classification.

Unit-II

Unconventional Machining Process: Principle and working and applications of unconventional machining process such as Electro-Discharge machining, Electro-chemical machining, ultrasonic machining, Abrasive jet machining etc.

Unit-III

Principle and working and application of unconventional machining processes such as laser beam machining, Electron beam machining, Ultrasonic machining etc.

Unit-IV

Unconventional welding processes: Explosive welding, Cladding etc. Under water welding, Metallising, Plasma are welding/cutting etc.

Unit-V

Unconventional Forming processes: Principle, working and applications of High energy forming processes such as Explosive Forming, Electromagnetic forming, Electro-Discharge forming, water hammer forming, explosive compaction etc.

References:

1. Modern Machining Processes – P.C. Pandey
2. Unconventional Machining – V.K. Jain
3. Modern Machining – G.F. Benedict

COMPOSITE MATERIALS

EPE-485

Course Outcomes (CO)		
1	Able to explain the different Composite materials. Able to explain the different types fibres used for creating composites.	CO1
2	Able to explain the processes involved for making the MMCs.	CO2
3	Able to explain the different Nano Composites like SMC, BMC etc.	CO3
4	Able to explain the different techniques that in used for the fabrication of composites.	CO4
5	Able to explain that the different applications of composites in different industries like Aero-Space, Automobile etc.	CO5

Unit-I

Definition and Classification of Composites, MMC, PMC, CMC. Reinforcing fibres - Natural fibres (cellulose, jute, coir etc), boron, carbon, ceramic glass, aramids, polyethylene (UHMWPE), polybenz-thiazoles etc.

Unit-II

Particulate fillers-importance of particle shape an size. Matrix resins-thermoplastics and thermosetting matrix resins. Coupling agents-surface treatment of fillers and fibres, significance of interface in composites.

Unit-III

Nanocomposites, short and continuous fibre reinforced composites, critical fibre length, anisotropic behaviour, SMC, BMC, DMC etc.

Unit-IV

Fabrication techniques, pultrusion, filament winding, prepreg technology, injection and compression moulding, bag moulding, resin transfer moulding, reaction injection moulding.

Unit-V

Properties and performance of composites. Applications.

References

1. K.K. Chawla, Composite Materials – Science & Engineering, Springer-Verlag, New York, 1987.
2. F.L. Matthews and R.D. Rawlings, Composite Materials: Engineering and Science, Chapman & Hall, London, 1994.
3. Dr Navin Chand, Tribology of Natural fiber Composites, Wood Head Publishing Limited, Eng

INDUSTRIAL TRIBOLOGY

EPE-488

Course Outcomes (CO)		
1	Able to explain the different wear processes in contacts between metallic, ceramic and polymeric surfaces.	CO1
2	Able to explain the processes of lubrication in all regimes.	CO2
3	Able to explain the friction phenomena.	CO3
4	Able to select a suitable lubricant for a specific application.	CO4
5	Able to select a suitable material combination for tribological contacts.	CO5

Unit-I

Introduction: Definition and Scope of tribology, Contact of solids, Surface topology, Surface interaction.

Unit-II

Friction: Definitions, Types, Friction laws, Modern theory of dry solid friction, Temperature of sliding surface, Mechanism of rolling friction, Friction instability, Friction of elastomers.

Unit-III

Wear: Definition, Classification, Theories of adhesives, Abrasives, Surface fatigue and corrosive wear, Miscellaneous wear theory such as Erosive, cavitation and Fretting wear, Wear of miscellaneous machine components such as gears, Plane bearings and rolling elements.

Unit-IV

Lubrication: Lubrication of bearing, Lubricant, Mineral Oil, Grease, Solid lubricant, Lubrication regime, Viscous flow, Reynolds equation and its limitations, Hydrodynamic lubrication, Hydrostatic lubrication, Elasto-hydrodynamic lubrication, Boundary lubrication, Squeeze films.

Unit-V

Applications: Application of tribology in manufacturing processes, Metal machining, Metal cutting, Tool wear, Action of lubricants, Friction welding, Extrusion process.

References:

1. Engineering Tribology P Sahoo Prentice Hall of India
2. Principles and Applications of Tribology D.F. Moore Pergamon Press
3. Fundamentals of Tribology Basu, Sengupta & Ahuja Prentice Hall of India
4. Tribology Handbook M.J. Neele.

AUTOMOBILE ENGINEERING LAB

PME-481

Course Outcomes (CO)		
1	Able to get the knowledge of various automobile parts and their applications.	CO1
2	Able to Dismantle and Assemble the automobile chassis and engine components	CO2
3	Able to Identify and differentiate components of SI & CI engines.	CO3
4	Able to Understand working of braking, steering, clutch, transmission, suspension systems.	CO4
5	Able to Differentiate various subsystems of two, three & four-wheeler vehicles	CO5

A minimum of 8 experiments from the following:

1. Study & experiment on steering system.
2. Study & experiment on braking system.
3. Study & experiment on ignition system.
4. Study & experiment on fuel supply system.
5. Study & experiment on transmission system.
6. Study & experiment on suspension system.
7. Study safety aspect of automobile design.
8. Study & experiment on Lighting or lubrication system.
9. Study & experiment on lubrication and cooling system.
10. Comparative study features of common small cars (such as fiat, Ambassador, Maruti, Matiz, Santro,Indica and its variations) available in India.
11. Comparative study & technical features of common scooters & motorcycles available in India. (Case study/term paper).
12. Comparative Study & Technical features of common heavy vehicles available in India. (Case study/term paper).
13. Engine tuning and carburettor servicing experiment.
14. Experiment & study of MPFI system.
15. Experiment on fuel consumption measurement.
16. Review experiment on IC Engines & modern trends.
17. Visit of an Automobile factory.
18. Study & experiment of main gear box and differential gear box.

* *Additional or any other experiment may be added based on contents of syllabi.