Semester I & II

S.No.	Title of theory course	L-T-P
1	IME 101/201 Engineering Mechanics	3-1-0
	Lab Course	
1	IWS 151/251 Workshop Practice	0-1-3

Other Courses

Sem I	Sem II
Mathematics-I	Mathematics-II
Engg. Physics-I	Engg. Physics-II
Engineering Mechanics	Engg. Chemistry
Electrical Engg	Computer Concepts & programming
Basic Electronics	Professional Communication
Environment Ecology	Remedial English

IME-101/201
ENGINEERING MECHANICS

L :T :P
3 :1 :0

Unit I

Two Dimensional Force Systems: Basic concepts, Laws of motion, Principle of Transmissibility of forces, Transfer of a force to parallel position , Resultant of a force system, Simplest Resultant of Two dimensional concurrent and Non-concurrent Force systems, Distributed force system, Free body diagrams, Equilibrium and Equations of Equilibrium, Applications.

Friction: Introduction, Laws of Coulomb Friction, Equilibrium of Bodies involving Dry-friction, Belt friction, Applications.

Unit II

Beam: Introduction, Shear force and Bending Moment, Differential Equations for Equilibrium, Shear force and Bending Moment Diagrams for Statically Determinate Beams.

Trusses: Introduction, Simple Truss and Solution of Simple truss, Method of Joints and Method of Sections.

Unit III

Centroid and Moment of Inertia: Centroid of plane, curve, area, volume and composite bodies, Moment of inertia of plane area, Parallel Axes Theorem, Perpendicular axes theorems, Principal Moment Inertia, Mass Moment of Inertia of Circular Ring, Disc, Cylinder, Sphere and Cone about their Axis of Symmetry.

Unit IV

Simple Stress and Strain: Introduction, Normal and Shear stresses, Stress- Strain Diagrams for ductile and brittle material, Elastic Constants, One Dimensional Loading of members of varying cross-sections, Strain energy.

Compound stress and strains: Introduction, state of plane stress, Principal stress and strain, Mohr's stress circle. Theories of Failure

Unit V

Pure Bending of Beams: Introduction, Simple Bending Theory, Stress in beams of different cross sections.

Torsion: Introduction to Torsion of circular shaft, combined bending & torsion of solid & hollow shafts.

Text books:

1. Engineering Mechanics by Irving H. Shames, Prentice-Hall
2. Mechanics of Materials by E.P.Popov, PHI
3. Engineering Mechanics by R.K.Bansal
4. Strength of Materials by Ryder
5. Mechanics of Material by Gere & Timoshenko
6. Engineering Mechanics by A. Nelson
7. Engineering Mechanics by U.C. Jindal
8. Engineering Mechanics Statics by J.L. Meriam & L.G.Kraige

IWS 151/251
WORKSHOP PRACTICE

L:T:P
0: 1:3

1. **Carpentry Shop :**

Practice (I): To prepare half lap corner joint from given pieces of mango wood.
Practice (II) : To prepare mortise and tenon joint from given pieces of mango wood.
Instructions: Description and demonstration of different tools, joints along with

advanced Carpentry joints, classification and definition of timber, wood seasoning, demonstration of wood working lathe and advanced power tools used in carpentry work, safety precaution during actual working

.

2. Fitting and Bench working Shop :

Practice (I): To prepare male- female joint from given pieces of mild steel.
Practice (II): To prepare practice work piece involving marking , measuring , sawing, drilling and tapping operations
Instructions: Classification and description of different tools used in fitting shop e.g. marking and measuring tools , holding and supporting tools, striking tools and cutting tools etc , safety precaution during actual working.

3. Black Smithy Shop :

Practice (I): To prepare ‘ L ’ shape job from given piece of mild steel rod by hand forging.
Practice (II): To prepare a ‘ Ring ’ from given piece of mild steel rod by hand forging.
Instructions: Description of various forging processes done in black-smithy work e.g. upsetting, drawing down, punching, bending, fullering etc, classification and description of different tools, equipments used in black-smithy shop, safety precaution during actual working.

4. Welding Shop :

Practice (I): To prepare simple butt joint and lap joint by electric arc welding from given pieces of mild steel
Practice (II): To prepare simple lap joint by oxy-acetylene gas welding and gas flame cutting practice.
Instructions: Concept of welding, classification and explanation of various types of welding with the help of flow chart, description of different tools. Equipments required for arc welding and gas welding, demonstration of various types of flames in Oxy acetylene gas welding, setting of current and selection of electrodes along with different welding joints, safety precaution during actual working.

5. Sheet Metal Shop :

Practice (I): To prepare a funnel complete with soldering from given G.I. sheet.
Practice (II): To fabricate tray / tool box or electric panel box from given G.I. sheet.
Instructions: Classification and description of different types of tools, equipments used in sheet metal work, different types of metals used in sheet metal shop e.g. Galvanized iron, black iron, copper, aluminum etc, concept of development of surfaces along with different types of joints in sheet metal work, safety precaution during actual working

6. Machine Shop :

Practice (I): To prepare a job by plain turning, facing, step turning and chamfering operation from given mild steel rod.
Practice (II): To prepare a job by taper turning, threading, knurling operations from given mild steel rod.
Instructions: Classification of lathe machines, different parts of lathe machine, tools and equipments used, explanation and demonstration of various operations on lathe machine, tool geometry of single point cutting tool, cutting speed, feed and depth of cut in turning, safety precaution during actual working.

7. Foundry Shop :

Practice (I) : To prepare a simple mould of given pattern in Green Sand.
Practice (II) : To prepare a mould with two step pulley with Runner and Riser.

Instructions : Description and use of various forging tools, showel, flat rammer, hand rammer, strike off bars, vent wire, trowels, hand riddle etc. Types of various moulding sands, types of patterns, pattern materials, pattern allowances, safety precautions during actual working.

Semester III

S/No.	Title of Theory Course	L-T-P
1	IMA Mathematics III	3-1-0
2	ICE Fluid Mechanics	3-1-0
3	IME 301 Strength of Materials	3-1-0
4	IME 302 Material Science	3-1-0
5	IME 303 Engineering Thermodynamics	3-1-0
	Lab Course	
1	IME 351 Applied Mechanics Lab	0-0-2
2	IME 352 Material Science Lab	0-0-2
3	IME 353 Machine Drawing Lab	0-0-2
4	ICE Fluid Mechanics Lab	0-0-2

IME 301
STRENGTH OF MATERIALS

L:T:P
3: 1: 0

Unit I

Stresses in Beams: Review of pure Bending**.** Direct and shear stresses in beams due to transverse and axial loads, composite beams.

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.

Unit II

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.

Deflection of Beams: Equation of elastic curve, cantilever and simply supported beams, Macaulay's method, area moment method Fixed beams. Castigliano's Theorem

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.

Unit IV

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, Ranking Gardon Formulae, Examples of columns in mechanical equipments and machines.

Unit V

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 due to interference fits.

Books :

1. Mechanics of Materials by E P Popov
2. Strength of Materials by Ryder
3. Strength of Materials by Timoshenko and & Ysungs
4. Mechanics of Materials by Bear Jhonson
5. Strength of material R. K. Rajput
6. Advanced Mechanics of Solid by L.S. Srinath

IME 302
MATERIAL SCIENCE

L:T:P
3: 1: 0

Unit I

Introduction: Importance of materials, Brief review of modern atomic concepts, atomic models, chemical bonding, metallic bonds.

Crystalline and non-crystalline structures; Concept of unit cell, Bravais space lattices, common crystal structures- cubic and hexagonally closed packed structures, co-ordination number, packing factor, Miller indices for crystallographic planes and directions, X-ray crystallography techniques. Micro structural examination and grain size determination. Structure-property interrelationship, comparative study of microstructure of various metals & alloys such as mild steel, cast iron, brass and bronzes.

Unit II

Structural imperfections- point, line, planer and volume defects. Dislocations in solids- edge, screw and mixed dislocations, energy of dislocations, Frank Reed source of dislocation, strain hardening, slip systems, twin and tilt boundary, grain boundary defects and their significance.

Diffusion in solids - Fick's first and second laws of diffusion.

Mechanical properties and testing: stress- strain diagram, ductile v/s brittle materials. stress v/s strength, toughness, hardness, fracture, fatigue and creep, Mechanical testing- tensile test, hardness test, impact test, fatigue test, creep test, non destructive evaluation.

Unit III

Phase diagram and equilibrium diagrams: Unary and binary diagrams, phase rules, types of equilibrium diagrams, types of solid solution, Hume-Rothery criteria of solid solution formation, intermetallic compounds.

Ferrous materials: Classification of steels, alloy steels, their applications, cast irons- its properties and uses. Iron carbon equilibrium diagram, time-temperature-transformation (T-T-T) curves- pearlite, bainite and martensite formations.

Heat treatment processes- annealing, normalizing, quenching, tempering, important case hardening processes.

Non-ferrous metals and alloys, brasses, bronzes, bearing materials- its properties and uses, aluminum alloys such as Duralumin.

Unit IV

Magnetic Properties: magnetism – dia-, para- and ferro-magnetism, hysteresis, Soft and hard magnets, Magnetic storages.

Electric properties: Energy band concept of conductor, insulator and semi-conductors, p-n junction and transistors, Basic devices and its application, Superconductivity and its applications, Messier effect, type I & II superconductors, high temperature superconductors.

Unit V

Ceramics- structure, properties and applications of ceramics, Polymers- types and its applications. Composite materials- its types and uses.

Performance of materials in service- brief theoretical consideration of fracture, fatigue, corrosion and its control.

Books/References:

1. W.D. Callister, Jr. – Material Science & Engineering Addison-Wesley Pub.Co.
2. Van Vlack – Elements of Material Science & Engg. , John Wiley & Sons
3. V. Raghvan – Material Science, Prentice Hall of India
4. Ashby & Jones, Engineering Materials, Vol. I &II, Pergemon Press.

IME 303
ENGINEERING THERMODYNAMICS

L:T:P
3: 1: 0

Unit – I:

Fundamental Concepts and Definitions: Introduction and definition of thermodynamics, Dimensions and units, Microscopic and Macroscopic approaches, Systems, surroundings and universe, Concept of continuum, Control system boundary, control volume and control surface, Properties and state, Thermodynamic properties, Pressure and its measurement, Thermodynamic path, process and cycle, Thermodynamic equilibrium, Reversibility and irreversibility, Quasi static process, Energy and its forms, Work and heat, Gas laws, Ideal gas

Zeroth law of thermodynamics: Zeroth law of thermodynamics, Temperature and its' measurement, Temperature scales.

First law of thermodynamics: Thermodynamic definition of work, Thermodynamic processes, Calculation of work in various processes and sign convention, Non-flow work and flow work, Joules' experiment, First law of thermodynamics, Internal energy and enthalpy, First law of thermodynamics applied to open systems, Steady flow systems and their analysis, Steady flow energy equation, Boilers, Condensers, Turbine, Throttling process, Pumps etc. First law analysis for closed system (non flow processes), Analysis of unsteady processes such as filling and evacuation of vessels with and without heat transfer, Limitations of first law of thermodynamics, PMM-I.

Unit – II:

Second law: Devices converting heat to work, Thermal reservoir, Heat engines, Efficiency, Devices converting work to heat, Heat pump, refrigerator, Coefficient of Performance, Reversed heat engine, Kelvin Planck statement of second law of thermodynamics, Clausius statement of second law of thermodynamics, Equivalence of two statements of second law of thermodynamics, Reversible and irreversible processes, Carnot cycle and Carnot engine, Carnot theorem and it's corollaries, thermodynamic temperature scale, PMM-II.

Entropy : Clausius inequality, Concept of Entropy, Entropy change in different thermodynamic processes, Tds equation, Principle of entropy increase, T-S diagram, Statement of the third law of thermodynamics.

Unit – III

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 pressure, volume and temperature, P-T & P-V diagrams, T-S and H-S diagrams, use of property diagram, Steam-Tables & Mollier charts, Dryness factor and it's measurement, processes involving steam in closed and open systems. Simple Rankine cycle.

Unit – IV

Availability and Irreversibility: Available and unavailable energy, Availability and Irreversibility, Second law efficiency, Helmholtz & Gibb's function.

Thermodynamic relations: Mathematical conditions for exact differentials. Maxwell Relations, Clapeyron Equation, Joule-Thompson coefficient and Inversion curve. Coefficient of volume expansion, Adiabatic & Isothermal compressibility.

Real gas,Law of corresponding states,Dalton's law,Amagat's law, Property of mixture of gases

Unit - V

Fuels and Combustion: Combustion analysis, Heating Values and its measurement, Air requirement, Air/Fuel ratio, Standard heat of Reaction and effect of temperature on standard heat of reaction, heat of formation, Chemical Equilibrium, adiabatic flame temperature.

Books:

1.Engineering Thermodynamics by Jones and Dugans, PHI Learning Pvt. Ltd.
2.Fundamentals of Thermodynamics by Sonntag, Van Wylen, Borgnakke John Wiley & Sons India Pvt. Ltd.
3. Thermodynamics : An engineering approach by Cengel & Boles, Mc Graw Hill
4. Thermodynamics by J.P. Holman, McGraw Hill.

IME 351
APPLIED MECHANICS LAB

L: T: P
0: 0: 2

1. To verify the law of polygon of forces.

2. To verify the laws of friction and to determine the coefficient of friction.

3. To determine the value of gravity g at a place by simple pendulum.

4. To determine the mechanical advantage, Velocity ratio and Efficiency of Worm & Worm Wheel and to determine its machine law.

5. To determine the mechanical advantage, Velocity ratio and Efficiency of Screw Jack and to determine its machine law.

6. To determine the mechanical advantage, Velocity ratio and Efficiency of a Double Purchase Crab and to determine its machine law.

7. To determine the M.I. of flywheel.

8. To determine the modulus of rigidity of a rod.

9. To determine the equivalent length of a compound pendulum.

10. To determine the modulus of elasticity of Wires by Searl's apparatus.

Minimum 8 experiments

IME 352
MATERIAL SCIENCE & TESTING LAB

L: T: P
0: 0: 2

1. To identify different kind of materials by observation.

2. To prepare specimen for metallographic examination.

3. To perform Jominy End Quench Test to determine hardenability of steel.

4. To determine Rockwell Hardness of given test specimen.

5. To determine Brinell Hardness of given test specimen.

6. To determine Vicker's hardness of given test specimen.

7. To perform tensile test on given specimen using UTM.

8. To perform Compression Test on given specimen using UTM.

9. To perform Izod & Charpy Impact test.

10. To perform Torsion test on given specimen.

11. To perform fatigue test on given specimen.

12. To perform Creep test.

13. To perform Bend (flexural) test on the given specimen.

Minimum 8 experiments

IME 353
MACHINE DRAWING LAB

L: T: P
0: 0: 2

1. Introduction: Graphic language, Classification of drawings, Principles of drawing, IS codes for Machine drawing, Lines, Scales, Sections, Dimensioning, Standard abbreviations.

2. Orthographic Projections : Principles of first and third angle projections, drawing and sketching of machine elements in orthographic projections, spacing of views.

3. Screwed (Threaded) fasteners: Introduction, Screw thread nomenclature, forms of threads, Thread series, Thread designation, Representation of threads, Bolted joints, Locking arrangement for nuts, Foundation bolts.

4. Keys and cotters: Keys, Cotter joints.

5. Shaft couplings: Introduction, Rigid and flexible coupling.

6. Riveted Joints: Introduction, Rivets and riveting, Rivet heads, Classification of riveted joints.

7. Assembly drawing: Introduction, Engine parts, Stuffing box etc.

8. Free hand sketching: Introduction, Need for free hand sketching, Free hand of sketching of some threaded fasteners and simple machine components.

References:
1. N.Siddeshwar, P.Kannaiah, V V S Shastry: Machine Drawing, TMH, New Delhi
2. K L Narayana, P. Kannaiah, K Venkat Reddy: Machine Drawing, New Age Intnl Publ
3. Engineering Drawing Practice for Schools & Colleges, SP46-1998 (BIS)

Semester IV

S/No.	Title of Theory Course	L-T-P
1	IME 401 Manufacturing Science and Engineering-I	3-1-0
2	IME 402 Heat and Mass Transfer	3-1-0
3	IME 403 Energy Conversion Systems	3-1-0
4	IME 404 Kinematics of Machines	3-1-0
5	IMA Computer Oriented Numerical Methods	3-1-0
6	ICS-401 Cyber Security (For CE,CH,CS,EE,ET,ME only)	
	Lab Course	
1	IME 451 Manufacturing Science and Engineering-I Lab	0-0-2
2	IME 452 Heat and Mass Transfer Lab	0-0-2
3	IME 453 Energy Conversion Lab	0-0-2
4	IMA Numerical Techniques Lab	0-0-2
Theory Course for B. Tech. BE, FT, OT, PT, PL, LT in IVth Semester		
1	IME-405 Elements of Mechanical Engineering	3-1-0

IME 401
MANUFACTURING SCIENCE AND ENGINEERING-I

L:T: P
3 :1 :0

Unit-I

Importance of manufacturing towards technological and social economic development. Classification of manufacturing processes. Survey of manufacturing processes. Manufacturing processes for common items, Concepts of Manufacturing Systems

Unit II:

Casting: 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.

Unit III:

Metal Forming Processes: Elastic & plastic deformation, yie ld 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. Analysis of Wire/strip drawing and maximum-reduction, 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-IV

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-V

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

Introduction to Rapid Prototyping and tooling.

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.

Books:

1. Manufacturing Science by Ghosh and Mallik
2. Production Engg. Science by P.C. Pandey
3. Production Technology by R.K. Jain
4. Manufacturing Technology by P.N. Rao., TMH
5. Materials and Manufacturing by Paul Degarmo.
6. Manufacturing Engineering & Technology by Kalpakjian, Pearson Pub.

IME 402
HEAT & MASS TRANSFER

L: T: P
3: 1 : 0

UNIT-1

Introduction to Heat Transfer:

Concepts of the mechanisms of heat flows; Conduction, convection and radiation; Effect of temperature on thermal conductivity of materials; Introduction to combined heat transfer mechanism.

Conduction:

One-dimensional general differential heat conduction equation in the rectangular, cylindrical and spherical coordinate systems; 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; Critical thickness of insulation.

UNIT-2

Numerical methods in heat conduction:

Finite difference formulation of differential equation, One-dimensional steady-state heat conduction, Solution methods for systems of algebraic equations, Two-dimensional heat conduction, Transient heat conduction.

Fins:

Heat transfer from extended surfaces, Fins of uniform cross-sectional area; Errors of measurement of temperature in thermometer wells.

Transient Conduction:

Transient heat conduction; Lumped capacitance method; Time constant; Unsteady state heat conduction in one dimension only, Heis ler charts.

UNIT-3

Forced Convection:

Basic concepts; Hydrodynamic boundary layer; Thermal boundary layer; Approximate integral boundary layer analysis; Analogy between momentum and heat transfer in turbulent flow over a flat surface; Mixed 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; Empirical heat transfer relations for natural convection over vertical planes and cylinders, horizontal plates and cylinders, and sphere ; Combined free and forced convection.

UNIT-4

Thermal Radiation:

Basic radiation concepts; Radiation properties of surfaces; Black body radiation Planck's law, Wein's displacement law, Stefan Boltzmann law, Kirchoff's law; ; Gray body; Shape factor; Black-body radiation; Radiation exchange between diffuse non black bodies in an enclosure; Radiation shields; Radiation combined with conduction and convection; Absorption and emission in gaseous medium; Solar radiation; Green house effect.

UNIT-5

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 outside & inside of a horizontal tube; Effect of non-condensable gases; Dropwise condensation; Heat pipes; Boiling modes, pool boiling;

Hysteresis in 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.

Books:

1. Elements of Heat transfer by Bayazitouglu & Ozisik, McGraw-Hill Book Company.
2. Heat Transfer By J.P. Holman, McGraw-Hill Internationa l edition.
3. Schaum's outline of Heat Transfer by Pitts & Sisson McGraw-Hill International edition.
4. Principles of Heat Transfer by Frank Kreith, McGraw-Hill Book co.
5. Fundamentals of Momentum, Heat and Mass Transfer by James R.Welty; John Wiley & Sons (Pvt). Ltd.
6. Heat and Mass Transfer by Cengel & Ghazar, TMH, 6^{th} ed.

IME 403
ENERGY CONVERSION SYSTEMS

L:T:P
3:1:0

Unit-I

Boilers: Steam generators-classifications. Working of fire-tube and water-tube boilers, boiler mountings & accessories, supercritical boilers, waste heat recovery steam boilers, 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-II

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

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-III

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 reaction, state point locus, Losses in steam turbines, Governing of turbines.

Unit-IV

Gas Turbine: Gas turbine classification Brayton cycle, Principles of gas turbine, Gas turbine cycles with intercooling, 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.

Unit-V

Compressors:

Classification, Reciprocating compressors, Single and Multi stage compressors.
Rotary compressors, Classification, Centrifugal compressor fundamentals, Surging and stalling, Roots blower, Vaned compressor, Air Motors.

Unconventional Energy Systems: sterling engines, Thermo- ionic converters, thermoelectric generators, Photovoltaic generators, Magneto-hydrodynamic generators

Books:

1. Applied thermodynamics by Onkar Singh, New Age International (P) Publishers Ltd.
2. Basic and Applied Thermodynamics by P.K. Nag, Tata Mc Graw Hill
3. Theory of Stream Turbine by W.J. Kearton
4. Steam & Gas Turbine by R.Yadav, CPH Allahabad
5. Gas Turbine, by V. Ganeshan, Tata Mc Graw Hill Publishers.
6. Gas turbine Theory & Practice, by Cohen & Rogers, Addison Weslay Long man
7. Reciprocating and Rotary Compressors, by Chlumsky, SNTI Pub., Czechoslovakia
8. Turbines, Compressors and Fans, by S.M.Yahya, Tata Mc Graw Hill Pub.

IME 404
KINEMATICS OF MACHINES

L:T:P
3: 1: 0

UNIT 1: Introduction: Aims & scope of the course & Basic concepts of Mechanisms.
Basic definitions, Difference between structure & Machine, Links & their types, Types of constrained motion, Kinematic pair & their classification, Grubler's mobility criteria, Inversion of a kinematic chain and applications, Hooks joint, Devis and Ackermann steering mechanism.
An introduction to approximate and exact straight line mechanism.

UNIT 2: Graphical (vector) method for velocity and acceleration of various mechanisms e.g. slider crank and four bar, Coriolis acceleration. Instantaneous centre method, Kennedy's theorem, Klien's construction

UNIT 3:
Transmission drives:
Belt, Rope and Chain drives: Types and materials, Fundamentals of Power transmission
Phenomena of slip & creep, centrifugal and initial tensions, Tight side and slack side tensions, Conditions of max. Power transmission.

UNIT 4: Brakes and Clutches: Types of braking systems force and torque analysis for block, band and band and block brake, disc brakes.
Friction clutches: types, uniform pressure and uniform wear theory.

UNIT 5
Theory of gearing: Classification of gears and terminology, Law of gearing, systems of gear teeth, gear profiles, Interference, and efficiency of gears, epicyclical gear train, Compound gear train, Torque analysis and various applications of complex gear trains.

Reference Books:
1. Theory of Machines by Thomas Bevan
2. Kinematics by HN Tyson
3. Theory of Machines by J E Shingley
4. Theory of Machines by S. S. Rattan

IME 451
MANUFACTURING SCIENCE & ENGINEERING - I LAB

L:T:P
0: 0: 2

Minimum 8 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. Injection moulding with plastics

5. Forging hand forging processes

6. Forging - power hammer study & operation

7. Tube bending with the use of sand and on tube bending m/c.

8. Press work experiment such as blanking/piercing, washer, making etc.

9. Bending & spring back.

10. Jigs & Fixture experiment

IME 452
HEAT & MASS TRANSFER LAB

L:T:P
0: 0: 2

Minimum 8 experiment of the following

1. Conduction - Composite cylinder experiment

2. Convection - Pool Boiling experiment

3. Convection - Experiment on heat transfer from tube-natural convection.

4. Convection - Heat Pipe experiment.

5. Convection - Heat transfer through fin- natural convection .

6. Convection - Heat transfer through tube/fin- forced convection.

7. Experiment on Stefan's Law, on radiation determination of emissivity, etc.

8. Experiment on solar collector, etc.

9. Heat exchanger - Parallel flow experiment

10. Experiment on Cooling tower

11. Experiment on critical insulation thickness.

12. Conduction - Determination of thermal conductivity of fluids.

13. Conduction - Thermal Contact Resistance Effect.

IME 453
ENERGY CONVERSION LAB

L:T:P
0: 0: 2

1. Study of Fire Tube boiler models

2. Study of Water Tube boiler models

3. Study of Reaction turbine models

4. Study of Impulse turbine models

5. Study of Steam Engine models.

6. Study of Gas Turbine Model

7. Study of mini steam power plant and experimentation

VISIT : Study through visit of a nearby Power Plant

Semester V

S/No.	Title of Theory Course	L-T-P
1	IME 501 Manufacturing Science and Engineering II	3-1-0
2	IME 502 I C Engines	3-1-0
3	IME 503 Dynamics of Machines	3-1-0
4	IME 504 Elements of Mechanical Design	3-1-0
5	IME 505 Measurement Systems	3-1-0
	Lab Course	
1	IME 551 Manufacturing Science and Engineering- II Lab	0-0-2
2	IME 552 I C Engine Lab	0-0-2
3	IME 553 Theory of Machines Lab	0-0-2
4	IME 554 Machine design-I Lab	0-0-2

IME 501
MANUFACTURING SCIENCE & ENGINEERING-II

L:T: P
3: 1: 0

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 for turning, milling and drilling. Cutting fluids/lubricants. Tool materials. Tool wear and tool life. Machinability. Force measurement. Brief introduction to machine tool vibration and surface finish. Economics of metal cutting.

Unit-II

Grinding & Super finishing

(i) Grinding: Grinding wheels, abrasive & bonds, cutting action. Grinding wheel specification. Grinding wheel wear - attritions wear, fracture wear. Dressing and Truing. Max chip thickness and grinding criteria. Surface and Cylindrical grinding. Centerless grinding.

(ii) Super finishing: Honing, lapping, polishing.

Unit-III

Joining Methods:

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.

Joining of non metallic components

Unit-IV

Machine Tools

(i) Lathe : Principle, construction, types, operations, Turret/capstan, semi/Automatic, Tool layout.

(ii) Shaper, slotter, planer : Construction, operations & drives.

(iii) Milling : Construction, Milling cutters, up & down milling. Dividing head & indexing. Various types of milling cutters.

(iv) Drilling and boring: Drilling, boring, reaming tools. Geometry of twist drills.

Unit V:

Tool Design:

Jigs & Fixtures: Locating & Clamping devices, Principles of design of Jigs and Fixtures, Types of Jigs & fixtures, and their applications.

Books

1. Manufacturing science by Ghosh and Mallik
2. Fundamentals of Metal Cutting and Machine tools by Boothroyd
3. Production Technology by R.K. Jain
4. Production Engineering Science by P.C. Pandey
5. Modern Machining Processes by P.C. Pandey & H.S. Shan
6. Manufacturing science by Degarmo
7. Fundamentals of metal cutting & machine tools – Juneja, Shekhon & Seth, New Age Publ.
8. Process & materials of manufacturing - Lindburg.

IME 502
I C ENGINES

L: T: P
3: 1: 0

Unit-1

Introduction to I.C Engines: Engine classification, Air standard cycles, Otto cycle, Diesel cycle, Dual cycle, Comparison of Otto, Diesel and Dual cycles, Sterling cycle, Ericsson cycles, Actual cycle analysis, Two and four stroke engines, SI and CI engines, Valve timing diagram, Rotary engines, stratified charge engine. 1

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

Unit–2

SI Engines:

Combustion in SI engine, Flame speed, Ignition delay, Abnormal combustion and it's control, combustion chamber design for SI engines.

Carburetion, Mixture requirements, Carburetor types, Theory of carburetor, MPFI.

Ignition system requirements, Magneto and battery ignition systems, ignition timing and spark plug, Electronic ignition.

Unit–3

CI Engine:

Combustion in CI engines, Ignition delay, Knock and it's control, Combustion chamber design of CI engines.

Fuel injection in CI engines, Requirements, Types of injection systems, Fuel pumps, Fuel injectors, Injection timings.

Scavenging in 2 Stroke engines

Unit-4

Engine Cooling: Different cooling systems, Radiators and cooling fans.

Lubrication: Engine friction, Lubrication principle, Type of lubrication, Lubrication oils, Crankcase ventilation.

Supercharging: Effect of altitude on power output, Types of supercharging.

Testing and Performance: Basic measurements, Optical measurement techniques, Laser Doppler anemometry, Testing of SI and CI engines.

Unit-5

Air Pollution from IC engine: IC engine emissions, Mufflers, Silencers, EGR, Effect of pollutants, Pollution measurement, Emission control in SI and CI engines, Pollution from Gas Turbines and its control, Noise pollution and its control, Emission legislations

Non-Conventional I.C. Engines: Dual fuel and Multifuel engines, Stratified charge engine, Free piston engine, Stirling engine, Wankel rotary engine.

BOOKS:

1. Fundamentals of Internal Combustion Engine by Gill, Smith,Ziurs, Oxford & IBH Publishing Co.
2. IC Engines, by Rogowsky, International Book Co.
3. A Course in International Combustion Engines, by Mathur & Sharma, Dhanpat Rai & Sons.
4. I.C Engine Analysis & Practice by E.F Obert.
5. I.C Engine, by Ganeshan, Tata Mc Graw Hill Publishers.
6. I.C Engine, by R. Yadav, Central Publishing House, Allahabad

IME 503
DYNAMICS OF MACHINES

L:T:P
3:1:0

Unit 1: Introduction of cam and follower, Terminology, classification, types of follower motion, Analysis of cam and follower motion.

Unit 2: Introduction to gyroscope, precisional motion and Gyroscopic couple, Effect of gyroscope couple in aero plane, effect of gyroscopic couple on naval ship during steering, pitching and rolling, Stability of Four wheel and two-wheel vehicle during turning.

Unit 3: Flywheels: Fluctuation of energy and speed, Application of flywheel to various operations and mechanisms of machine.

Governor: Terminology, Classification of governors, function, analysis of various types of governors viz. Wald's, Proel, Hartnell.

Unit 4:

Velocity and acceleration of Slider crank mechanism, Analytical method for velocity and acceleration of the piston, angular velocity and acceleration of connecting rod. Force analysis of reciprocating engine mechanism and inertia torque calculations.

Balancing of rotating and reciprocating masses: methods of balancing the primary and secondary unbalanced forces, partial balancing, field balancing

Unit 5:

Introduction to Mechanical Vibration: SHM, 1D and 2D problems of free, damped and forced vibrations. Vibration isolation, transmissibility, critical speed of shaft. Vibration measuring instruments. Exact and approximate numerical methods in vibrations. Raleigh, Dunkerlay, Stadola methods.

Books:

1. Theory of Machines by Thomas Bevan
2. Theory of Machines by J.Lal and Shah
3. Grover, G.K. "Mechanical Vibrations" Nem Chand Publishers, Roorkee
4. Theory of Machines by S. S. Rattan

IME 504
ELEMENTS OF MECHANICAL DESIGN

L:T: P
3: 1: 0

UNIT-I

Introduction, Definition, Methods, standards in design, considerations in design.

Selection of materials: Importance, Classification of Engineering Materials, different kind of steels & cast irons, steel designation, Materials for components subjected to creep, static and fatigue loads, Importance of ceramics, plastics & rubbers for Engineering applications, ASTM testing methods.

UNIT-II

Design for static load.

Modes of failure, Factor of safety, stress-strain relationship, principal stresses, theories of failure

Design for dynamic loads: types, effect w.r.t. static loads, stress concentration, Fluctuating/alternating stresses, fatigue failure, endurance limit, design for finite & infinite life, Soderberg & Goodman criteria., design for fatigue, creep and fracture, design for contact stresses and residual stresses

UNIT-III

Joints

Riveted joints, failure of rivets, welded joint, screwed joints, eccentric loading of above joints, and 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.

Text Book

1. M/C Design by J.E. Shigley., 6th Edition, Tata MacGrow Hill.

References Books:

1. Design of M/C Elements by M.F. Spots.
2. Mechanical Engineering Design by Shigley
3. M/C Design by Sadhu Singh.
4. Machine Design by Bhandari.
5. M/C Design by Sharma & Agarwal.
6. Product Development & Design by Tarun Soota
7. Material Science & Engineering by Callister Jr.

IME 505
MEASUREMENT SYSTEMS

L:T:P
3:1:0

Unit I

Measurement: basic definitions- accuracy, precision, repeatability, reproducibility, reliability, maintainability, sensitivity, span, zero drift, ageing etc.

Measurement system-basic components, types of measurement direct & indirect active and passive transducers, digital and analog systems, null and deflection type devices.

Transducers- mechanical and electrical transducers, basic requirements for transducers

Calibration- steps in calibration; Standards -primary, secondary, reference and working standards.

Errors: types of errors-application v/s operational errors, dynamic error, environmental error, absolute v/s relative errors, random errors, uncertainty and bias.

Unit II

Measurement of displacement, force and torque, Measurement of pressure and temperature, Measurement of fluids flow Study of working of Bourdon tube pressure gauge, LVDT, Cathode Ray Oscilloscope.

Unit III

Electrical strain gauges-working principle, materials, transverse sensitivity, Wheatstone bridgesfull, half, and quarter bridge circuits, strain rosette.

Optical methods in measurement: Laser Beam as light pointer, length and displacement measurement, Laser Doppler anemometer, Temperature sensor

Unit IV

Control: basic definitions, elements of control system -open loop and closed loop systems.

Concept of feedback control system; Block. Diagram representation, its simplification and reduction.

Transfer function, Laplace transformation, transfers function of various systems, Analogous system- mechanical and electrical analogy.

Unit V

Test signals-step ramp, parabolic and impulse signals.

Time response for I_{st} and 2_{nd} order system

Basic concept of stability

Time response analysis- Routh's criteria, Root locus technique.

Frequency response- Bode and Polar plot

Books:

1. Mechanical Measurements- System and Design, E O Deobelin
2. Mechanical Measurement, Buck & Beckwith
3. Instrumentation, Sarma, Rangam & Mani
4. Control System Engineering, Nagrath & Gopal
5. Engineering Control System, K. Ogata

IME-506
For B. Tech. - BE, FT, OT, PT, PL, LT in IVth Semester
ELEMENTS OF MECHANIAL ENGINEERING

L T P
3 1 0

Unit I

Properties of steam

Pure substance, Property of steam, Triple point, Critical point, Sub-cooled liquid, Saturation states, Superheated states, Phase transformation process of water, Graphical representation of pressure, volume and temperature, P-T & P-V diagrams, T-S and H-S diagrams, use of property diagram, Steam- Tables & Mollier charts, Dryness factor and it's measurement, 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

Centrifugal Pumps

Classifications of centrifugal pumps, Vector diagram, Work done by impellor, Efficiencies of centrifugal pumps, Specific speed, Model testing, Cavitation, Separation and their control, Performance characteristics.

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.
Hydraulic accumulator, Special duty pumps, Intensifier, Hydraulic press, Air lift pumps

Unit IV

Strength of material

Shear Stresses in Beams, struts and columns

Unit V

Miscellaneous topics: Compressors, their classification**,** Atomizers, Centrifuges, Steam ejectors, homogenizers, chillers

Books:

1. Thermodynamics : An engineering approach by Cengel & Boles, Mc Graw Hill
2. Thermodynamics by J.P. Holman, McGraw Hill.
3. Hydraulic Machines by Jagdish Lal, Metropolitan book co. pvt ltd.
4. Hydraulic Machines: Theory & Design, V.P.Vasandhani, Khanna Pub
5. Elements of Strength of Material by Timoshinko and Young
6. Engineering Mechanics by R.K.Bansal

IME 551
MANUFACTURING SCIENCE & ENGINEERING - II LAB

L:T:P
0: 0: 2

Minimum 8 experiments out of the following

1. Shear-angle determination (using formula) with tube cutting (for orthogonal) on lathe Machine.

2. Taper turning operation on lathe.

3. Bolt (thread) making on Lathe machine.

4. Tool grinding (to provide tool angles) on tool- grinder machine.

5. Gear cutting on Milling machine.

6. Machining a block on shaper machine.

7. Finishing of a surface on surface- grinding machine.

8. Drilling holes on drilling machine and study of twist-drill.

9. Study of different types of tools and its angles & materials.

10. Experiment on tool wear and tool life.

11. Gas welding of a lap joint.

12. Arc welding of a lap/butt joint.

13. Resistance spot welding of two thin metallic sheets.

14. Soldering & Brazing experiment.

15. Experiment on Electro discharge machining.

16. Macro and Microstructure of welding joints, HAZ.

IME 552
I C ENGINE LAB

L:T:P
0 :0: 2

1. Study and working of Two stroke petrol Engine

2. Study and working of Four stroke petrol Engine

3. Determination of Indicated H.P. of I.C. Engine by Morse Test

4. Prepare the heat balance for Diesel Engine test rig

5. Determination of ihp, bhp and mechanical efficiency of a Diesel Engine

6. Study and working of four stroke Diesel Engine.

7. Determination of volumetric efficiency and draw indicator (P-V) diagram of reciprocating compressor

8. To draw the valve timing diagram of a four stroke diesel engine.

Any other experiment as per need of the subjects

IME 553
THEORY OF MACHINE LAB

L:T:P
0: 0: 2

1. To draw the slider displacement v/s crank angle and time v/s velocity curves for a slider crank mechanism and compare with theoretical; values.

2. To determine the ratio of time and maximum velocities for quick return motion using crank and lever mechanism

3. To study various approximate line drawing mechanism.

4. To determine the ratio of angular speeds of shafts in a Hooke's Joint.

5. To determine the coefficient of friction between flat belt and pulley.

6. To determine the Moment of Inertia of a plane disc by using a gyroscope.

7. To study quick return mechanism to get ratio of angle for forward stroke to return stroke.

8. To determine the forces on a spring in a Hartnell Governor to determine the spring stiffness.

9. To study the motion of the follower with the given profile of the cam and to determine the displacement, velocity and acceleration at all the points.

10. To study the working of Oldham's coupling.

11. To determine the speed ratio of a spur gear.

Minimum 8 experiments

IME 554
MACHINE DESIGN- I LAB

L:T:P
0:0:2

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. Design & drawing of a cotter joint.

5. Design & drawing of a knuckle joints.

6. Design & drawing of a simple screw jack.

7. Design of shaft for different loading conditions.

8. Design & drawing of rigid coupling(flanged type).

9. Design & drawing of a flexible coupling (pin-bush type)

10. Design & drawing of a leaf spring for an automobile.

11. Design & drawing of a helical spring for a given application

12. Product Development Design problems/exercise

Note -
1. Students may be advised to use design data book for design.
2. Drawing shall be made wherever necessary on small drawing sheets
3. Any eight experiments are to be completed
4. In case of shortage of time the design part of the experiment can be completed in the tutorials.

References:

1. Design data handbook by Mahadevan
2. Machine Drawing by Siddeshwar, Kannaiah, Shastry
3. Machine Design by Khurmi
4. Machine Drawing by N.D. Bhatt

Semester VI

S/No.	Title of Theory Course	L-T-P
1	IME 601 Fluid Machinery	3-1-0
2	IME 602 Design of Mechanical Components	3-1-0
3	IME 603 Computer Aided Design	3-1-0
4	IME 604 Management of Production System	3-1-0
5	ELECTIVE I (IME-611 to 617)	3-1-0
	Lab Course	
1	IME 651 Fluid Machinery Lab	0-0-2
2	IME 652 Machine Design-II Lab	0-0-2
3	IME 653 Measurement and Metrology Lab	0-0-2
4	IME 654 Seminar	0-0-3
Theory Course for B. Tech. BE, FT, OT, PT, PL, LT in VIth Semester		
	IME-605 Machine Design	3-1-0

ELECTIVE I

- IME 611: Product Design and Development
- IME 612: Engineering Materials
- IME 613: Mechatronics
- IME 614: Advanced Fluid Mechanics
- IME 615: Introduction to Nuclear Engineering
- IME 616: Production Planning and Control
- IME 617: Industrial Automation

IME 601
FLUID MACHINERY

L: T: P
3: 1: 0

UNIT-I

Introduction:

Classification of Fluid Machines & Devices, 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 & *c*urve), 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:

Francis 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 speed, Performance characteristics, Selection of water turbines.

UNIT-III

Centrifugal Pumps:

Classifications of centrifugal pumps, Vector diagram, Work done by impellor, Efficiencies of centrifugal pumps, Specific speed, Model testing, Cavitation & separation and their control, Performance characteristics.

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, Special duty pumps, Intensifier, Hydraulic press, Lift and cranes, Theory of hydraulic coupling and torque converters, Performance characteristics.

Water Lifting Devices:

Hydraulic ram, Jet pumps, Air lift pumps.

BOOKS:

Hydraulic Machines by Jagdish Lal, Metropolitan book co. pvt ltd.
Hydraulic Machines: Theory & Design, V.P.Vasandhani, Khanna Pub.
Applied Hydraulics by Addison
Hydraulic Machines by R K Rajput, S.Chand & co Ltd.
Hydraulic Machines by D S Kumar
Fluid Mechanics & Hydraulic Machines by R.K. Bansal
Fluid Mechanics, Fluid Machines & Hydraulics by V.P.Gupta, Alam Singh, Manish Gupta

IME 602
DESIGN OF MECHANICAL COMPONENTS

L:T:P
3: 1: 0

UNIT 1

Spur Gears: Conjugate action, involute gears, gear cutting methods, tooth loads, strength of spear gears in bending and in wear. Dynamic loading, Gear materials, design of gears and involute splines. Gear profile corrections, AGMA and Indian standards.

UNIT II

Helical Gears: Tooth relationship, tooth proportions. Design of helical gears, crossed helical gears, AGMA and Indian standards.

Worm And Bevel Gears: Analysis of loads and stresses, power rating, efficiency. Gear standard and proportions.

Unit III

Bearing: Types of ball bearings, roller bearing, needle roller bearing, life of bearing, reliability considerations, Selection of ball, roller, tapered roller and thrust bearings,

Sliding Bearings: Hydrodynamic theory of lubrication, types of bearings, design of bearings using design charts, boundary lubrication, hydrostatic bearings, hydrodynamic thrust bearing.

Unit IV

Design of Pressure Vessel: thick cylinder, thin cylinders, cylinder heads and cover plates, safety devices and standards of high pressure vessels

UNIT V

Engine Parts: Design of engine parts such as connecting rod, crankshaft and cylinder & piston.

Text Book

1. Machine Design by Shigley, Tata MacGrow Hill, 6th Edition/ 7th Edition

References Books:

1. Machine Design by P.C. Sharma & D.K. Agarwal.
2. Machine Design by Black and Adames
3. Design of Machine Members by Valance & Doughty.
4. Machine Design by Khurmi.
5. Practical gear Design by Dudley
6. Design Data book (PSG) for practical class.
7. Machine Design by Bharday.

IME 603
COMPUTER AIDED DESIGN

L:T:P
3:1:0

UNIT-1 Introduction to CAD, Application of Engineering Graphics in Design. Hardware in computer Aided Design Workstation, Graphic Terminals. Input output devices. The Central Processing Unit, Secondary Storage problems. Computer Graphics Software. Software Configuration of a graphic station and function of graphics. Graphics Standard for CAD.
UNIT-2 Construction of geometry, transformation, data base structure and content.- Representation of Curves-Beizer curves, Cub ic spline curve, B-spline curves. Surface Modeling techniques- surface patch, coons patch, bi-cubic patch- Bezier and B- spline surfaces. Volume Modeling-Boundary Models and CSG Modeling techniques.- Other CAD features and CAD/CAM Interaction.
UNIT-3 Application in Modeling, use of 3-D Modeling for 2D representation. 3-D Modeling for Geometric problem solving and examples of 3D-Modeling. Introduction to Information Technology and Data Base. Introduction to Finite Element Method.
UNIT-4 Introduction to Finite Element Method fundamentals: History and recent developments, mathematical models, variational formulations, integral formulations, Introduction to meshless approach.
UNIT-5 Application of FEM in 1D and 2D problems of solid and structural mechanics and Heat transfer.

Books:
1."CAD/CAM" by Mikell P. Groover and E. W. Zimmers. Prentice hall India Ltd.
2.Computer Graphics by Hearn and Baker
3. An Introduction to Finite Element Method by J.N.Reddy, TMH
Reference Books:
1.Computer aided analysis and deign by Wselfendate butleworth publication.
2.Basant, C.B. and Lui, Ghol K. "Computer-Aided Design and computer-Aided manufacturer, 3rd Edition.
3.Davis, B. L. Robothom, AJ. aid yer wood, "A Computer Aided Drawing and Design" Chapman of Hall (1991).
4.Engineering Graphics with Auto CAD-2002 by Bethume (PH).

IME 604
MANAGEMENT OF PRODUCTION SYSTEMS

L:T:P
3:1:0

Unit I

Production and production systems, Planning analysis and control of production systems, forecasting, Design and Development of Product and Services, Principles of Product development.

Unit II

Concepts of Production economics: types, nature of cost, breakeven analysis.
Operations economy, discounted cash flow, capital rationing, Pay back method.

Unit III

Introduction to Resource scheduling, Resource constants, Resource definition, allocation, aggregation and lending of resources, CPM.

Unit IV

Productivity improvement Techniques Personnel management, Human factors, human abilities, placements, training, motivation, safety supervision. Work environment; Facilities Planning: Plant location, location economics, types of production layouts, facilities layout, CRAFT work place design, working conditions. Motion and time study: Principles of motion economy, SIMO charts, Time study, work sampling.

Unit V

Techniques of Production control - MRP, MRP II and JIT.
Introduction to Quality management, Introduction to Maintenance Engg.

Books:

1. Production Systems: Planning analysis and control' by James L Riggs; John Wiley and Sons

2. Operations Management – Buffa.

IME 651
FLUID MACHINERY LAB

L: T: P
0: 0: 2

Minimum 8 experiments from following

1. Impact of Jet experiment.

2. Experiment on Pelton wheel.

3. Experiment on Francis turbine.

4. Experiment on Kaplan turbine.

5. Experiment on Reciprocating pump.

6. Experiment on centrifugal pump.

7. Experiment on Hydraulic Jack/Press

8. Experiment on Hydraulic Brake

9. Experiment on Hydraulic Ram

10. Experiment/test rig such as comparison & performance of different types of pumps and turbines.

11. Experiment for measurement of drag and lift on aerofoil in wind tunnel

12. Experiment on Jet Pump

13. Experiment on Gear oil Pump

VISIT : Study through detailed visit of any water pumping station/plant

IME 652
MACHINE DESIGN-II LAB

L:T:P
0: 0: 2

I. Computer and Language -
Introduction to computer and languages such as C Input-output statements, control statements, if, for, while, switch statement etc., Function and its uses, Structures to make student able to write computer program in C. Preparation of library file for important design data e.g. material properties and relevant data

II. WRITING COMPUTER PROGRAM FOR CONVENTIONAL DESIGN
1. Program for designing circular shaft

2. Program for designing Helical gear

3. Program for designing Bevel gear

4. Program for designing Spur gear

5. Program for designing Sliding bearing

6. Application of CAD drafting package

III. Design Problem as a mini project
Student will be given a real life design problem and they have to complete design of it manually, using hand-book etc, they can also take help of computer & programming, if needed.

IV. 2D & 3D modeling using drafting CAD Tool (viz. AutoCAD)

References:

1. Learning C language by Kanitkar
2. Machine Design by Sadhu Singh

IME 653
MEASUREMENT & METROLOGY LAB

L:T :P
0 :0 : 2

1. To measure the taper of a given shaft.

2. To measure the pitch diameter of a screw thread by a 3-wire method.

3. To measure the thread angle of screw by three wire method.

4. To measure the dimensions of a gear tooth using vernier calipers.

5. Study of slip gauges.

6. Study of limit gauges.

7. To measure out of roundness of a shaft.

8. To perform the concentricity test on a spur gear.

9. To calibrate a dial gage.

10. To study and use of autocollimator.

11. To determine the speed of pedestal fan using stroboscope.

12. To calibrate and measure pressure using Bourdan Pressure tube.

13. To measure strain using electrical strain gauge with Wheatstone bridge circuit.

14. To calibrate and measure temperature using Thermocouple.

15. Experiment on Photo elastic bench

16. Mounting of strain gauge

17. Stress measurement using strain gauge

Minimum 8 experiments.

IME 654
SEMINAR

L:T:P
0: 0: 3

- A Seminar will be delivered by each third year student on existing and emerging technologies in Mechanical and allied fields.

- The minimum time limit for the seminar will be about half an hour for each student.

- The Topic of the seminar will be submitted by the students to the teacher concerned with in the stipulated time set by the teacher

- Once topic is cleared by the teacher the students will make the presentation on the given date and time to the class

- A seminar report hard copy and presentation copy (e-format) must be submitted by the student on the day of presentation.

Equipment provide for the seminar: LCD projector, Computer, OHP (on demand), students may also prepare charts etc. if needed

ELECTIVE I

IME 611
PRODUCT DESIGN AND DEVELOPMENT

L:T:P
3:1:0

Unit I

Introduction to Product Design

Introduction to PDD, Applications, Relevance, Product Definition, Scope, Terminology. Design definitions, the role and nature of design, old and new design methods, Design by evolution. Examples such evolution of bicycle, safety razor etc. Need based development, technology based developments. Physical reliability & Economic feasibility of design concepts.

Unit II

Morphology of Design

Divergent, transformation and convergent phases of product design. Identification of need, Analysis of need. Design for what? Design criteria, functional aspects. Aesthetics, ergonomics, form (structure). Shape, size, color. Mental blocks, Removal of blocks, Ideation Techniques. Creativity, Checklist.

Unit III

Transformations

Brainstorming & Synectics. Morphological techniques. Utility concept, Utility value, Utility index. Decision making under multiple criteria. Economic aspects of design. Fixed and variable costs. Break-even analysis.

Unit IV

Reliability

Reliability considerations, Bath tub curve, Reliability of systems in series and parallel. Failure rate, MTTF and MTBF. Optimum spares from reliability consideration. Design of displays and controls, Man-Machine interface, Compatibility of displays and controls. Ergonomic aspects. Anthropometric data and its importance in design. Applications of Computers in product design

Unit V

Design for manufacturing

Overview of the DFM process, Estimate the manufacturing cost, Reduce the cost of components, Reduce the cost of assembly, Reduce the cost of supporting Considerations of impact of DFM on other factors. Introduction to Patent and Intellectual property.

Recommended Books:

1. Product Design & Manufacturing - A.K.Chitab & R.C.Gupta, PHI (EEE).
2. The Technology of Creation Thinking - R.P. Crewford – Prentice Hall
3. The Art of Thought – Grohem Walls – Bruce & Co., New York
4. Product Design & Decision Theory - M.K. Starr - Prentice Hall
5. Human Factor Engg. – Mccormick E.J., Mc GrawHill.
6. Engineering: An Introduction to Creative profession – G.C. Beakley Hw leach, Macmillan.
7. Industrial Design In Engineering – A marriage of Techniques – Charles H . Flurscheim, The Design Council - London.
8. Quality Control & Reliability Analysis – Bijendra Singh, Khanna Publications.
9. Product Design and Development by Karl T Ulrich, Steven D. Eppinger

IME 612
ENGINEERING MATERIALS

L:T:P
3:1:0

Unit I

Introduction to materials, types of materials – metals, ceramics, polymers, composites, semiconductors, biomaterials. Structure-Property-Processing Relationship.

Mechanical testing and properties – Tensile test, Impact test, Fatigue test, Creep test, Hardness test, etc. Physical properties – electrical, magnetic, optical and thermal properties.

Unit II

Engineering materials- Metals and alloys: Ferrous and Non- ferrous alloys. Classification of Iron and Steel, Plain Carbon Steel, Alloy Steel, Cast Iron.

Non-Ferrous Alloys: Al alloys, Mg alloys, Be alloys, Cu alloys, Ni & Co alloys and Ti alloys.

Unit III

Ceramic material, Crystalline and non-crystalline struc ture, Application and properties of ceramics, Processing of ceramics.

Polymers: Structure of polymers, Degree of polymerization, Structure and properties of thermoplastics, thermosets and elastomers (rubbers), Additives to polymers. Processing of Polymers.

Unit IV

Composite Materials: Importance, Classification of composites - Particulate reinforced, Fibre reinforced composites, Composite Laminates, Sandwich and Honeycomb structures, Wood composites, Concrete, Degradation and failure of materials, Scope of recycling.

Unit V

Advanced Engineering materials: Materials for high temperature applications, Functionally graded materials, Concept of Smart and Intelligent materials.

Reference Books:

1. Engineering Materials Vol. I & II by Ashby & Jones, Pergemon Press
2. The Science & Engg. of Materials by Donald R Askeland PWS Engg.
3. W.Callister D. Jr., Material Science & Engineering, Addison-Wesley Pub. Co.

IME 613
MECHATRONICS

L:T:P
3:1:0

Unit I
Introduction: Integrated Mixed Systems. Integration of Mechanical Engineering, Electronics & Control Engg. And Computer Science.

Unit II
Dynamic Systems Modeling and Simulation: Equations of motion, transforming, physical model to Math. Model, linearization, Frequency response.

Unit III
Control Systems: Performance specifications, Transfer functions, Stability, Controller types and their design using frequency domain and Laplace domain method, PID control. Digital Control, z-transforms, problems in analogue to digital conversion-Nyquist frequency, Digital controller design.

Unit IV
Sensors and Actuators: Temperature-Sensing Thermocouples, Stress, Strain and Force measurements using strain gauges, Piezoelectric strain sensors and Accelerometers. Analog / Digital Position Measurements, Velocity Measureme nts. Direct Current Motors, Stepper Motors, Piezoelectric Actuators.

Unit V
Electronics: AD and DA converters, Op Amps, Microprocessors, Digital signal processing, Logic Circuit Devices, Gates- AND, OR, NAND etc. and combinations.
Study of Some Mechatronics Devices: Hard disk drive, dot matrix printer, optical sensing and control mechanism in NC machine tools etc.

Books:
1. Mechartonics by Hindustan Machine Tools Ltd., McGraw Hill Education
2. Mechartonics Principles, Concepts and Applications by N.P.Mahalik, McGraw Hill Education
3. Introduction to Mechartonics and Measurement Systems by Alciatore David G.and Histand Michael B., McGraw Hill Education

IME 614
ADVANCED FLUID MECHANICS

L:T:P
3:1:0

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 sourcesink 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 aerofoils.

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, Expans ion 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.

Books/ 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. Fluid Mechanics by A.K. Jain
6. Fluid Mechanics by Robert W. Fox & Alan T. Mc Donald, Wiley Students Edition
7. Fundamentals of Compressible flow by S.M. Yahya
8. Gas Dynamics by Z. Hussain
9. Viscous fluid flow by White
10. Computational Fluid Dynamics by Anderson
11. Gas Dynamics by E. Radhakrishnan

Fluid Mechanics by Kundu & Cohen, Academic Press, Elsevier

IME 615
INTRODUCTION TO NUCLEAR ENGINEERING

L:T:P
3:1:0

UNIT-1

Nuclear forces and binding energy of the nucleus, Nuclear stability and radioactivity, Law of radioactive decay.

Binary nuclear reactions, Energy release in fission and fusion reactions, concepts of microscopic and macroscopic cross sections.

UNIT-2

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.

UNIT-3

Heat generations and steady state temperature distribution in fuel elements, Heat removal, single and two phase heat transfer and fluid flow correlations.

Thermodynamic analysis of a nuclear power plants.

UNIT-4

Neutron lifetime, Delayed neutrons, Concept of reactivity and point reactor kinetics, Qualitative discussion of safety and radioisotopes in industry, Agriculture & medicine.

Brief discussion of safety and radioactive waste disposal.

UNIT-5

Interaction of nuclear radiation with matter, Shielding, Radiation exposure & dose, Applications of nuclear radiation & radioisotopes in industry, Agriculture & medicine.

Books:

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. Nuclear Electricity, by Ian Hore-Lacy.

IME 616
PRODUCTION PLANNING & CONTROL

L:T :P
3 :1 :0

Unit-I

Introduction: Types and characteristics of production systems Objective and functions of Production, Planning & Control, Place of production, planning in Engineering, manufactures organization.

Preplanning: Forecasting & Market Analysis. Factory Location & Layout, Equipment policy and replacement. Preplanning production, capacity planning.

Unit-II

Production Planning: Aggregate Planning, MPS, Material Resource Planning, Selection of material methods, machines & manpower. Routing, Scheduling and Dispatching and its sheets & charts, Production Line Balancing

Unit-III

Production and Inventory Control: Progress control through records and charts. Types of inventories, Inventory Classification. Inventory Control under constraints Economic lot (batch) size. Trends in purchasing and store keeping, JIT production MRP II, comparison of Push & Pull systems, ERP, CAPPC.

Unit-IV

Productivity: Importance, Productivity patterns, productivity measurements & ratios, improvement maintenance process.

Human Factors & Ergonomics: Human abilities, Training & motivation safety programs, workplace design & working conditions.

Unit-V

System Economics & Operations Economy: System Economics: Life cycle analysis, Capacity planning, Decision support system.

Operations Economy: Replacement Planning, Sensitivity Analysis, Capital rationing, Product cost analysis and estimation, Allocation of resources.

Books:

1. Elements of Production Planning & Control –Eilon
2. Production Planning & Control – Jain and Agarwal
3. Operations Management – Buffa.
4. Production System – J.L. Riggs.

IME 617
INDUSTRIAL AUTOMATION

L:T:P
3:1:0

Unit 1

Introduction:

Concept and scope of industrial automation, Socio-economic considerations.

Fluid Power Control:

Fluid Power Control elements and standard graphical symbols for them, Construction and performance of fluid power generators,

Unit 2

Hardware and circuits:

Hydraulic & pneumatic cylinders - construction, design and mounting,
Hydraulic & pneumatic valves for pressure, flow & direction control, Servo valves and simple servo systems with mechanical feedback,
Simple hydraulic and pneumatic circuits.

Unit 3

Pneumatics:

Pneumatic Logic Circuits: Boolean Algebra, Truth tables, Un-complementation algorithm and Karnaugh Maps, Design of pneumatic logic circuits for a given time displacement diagram or sequence of operation.

Unit 4

High Volume Production Systems :

Transfer devices & feeder, classification, construction & application, automated flo w lines, analysis of automated flow lines for reliability and efficiency, assembly systems.

Unit 5

Mechatronics

Mechanical system interfacing, Simple mechatronic devices: Stepping motors, DC motors, Analog / digital conversion.

Books/References-

1. Fluid Power with Applications by A. Esposito
2. Pneumatic Systems by S.R. Majumdar
3. Assembly Automation and Product Design, by Geoffrey Boothroyd, CRC press
4. Automation, production System and Computer Integrated Manufacturing by M.P.Groover

IME-605: MACHINE DESIGN
For B. Tech. - BE, FT, OT, PT, PL, LT in VIth Semester

L : T: P
3 : 1: 0

Unit-I
Introduction to the methodology of Engineering design; Design circle for a product/ system; Important considerations in design; Formulation of design concepts; Miscellaneous considerations like wear, environmental, human and aesthetic aspects; Ergonomics considerations.

Unit-II
Estimation of design load under static and dynamic conditions; Design for safety; Stress concentration and its effect and its prevention; Consideration of creep, fatigue and thermal stresses in design.

Unit-III
Material selection in design; Important engineering materials- Their classification and properties, metals and alloys, material selection in design

Unit IV
Design of power transmission systems- belt, pulley and geared transmission, Design of riveted and welded joints; Design of keys, couplings, lever and brackets.

Unit-V
Design of pressure vessels- thick and thin cylinders, pipe and joints, flanges and valves.

Books:
1. Machine Design by Shigley, Ta ta MacGrow Hill, 6th Edition/ 7th Edition
2. Machine Design by Khurmi Gupta
3. M/C Design by Sadhu Singh.
4. Machine Design by Bhandari.
5. M/C Design by Sharma & Agarwal.

Semester VII

S/No.	Title of Theory Course	L-T-P
1	IME 701 Computer Aided Manufacturing	3-1-0
2	IME 702 Refrigeration and Air Conditioning	3-1-0
3	IME 703 Advanced Manufacturing Processes	3-1-0
4	ELECTIVE II (IME-721 to 727)	3-1-0
5	Open Elective	3-1-0
	Lab Course	
1	IME 751 CAD/CAM Lab	0-0-2
2	IME 752 Refrigeration and Air Conditioning Lab	0-0-2
3	IME 753 Industrial/ Practical training and report presentation	0-0-2
4	IME 754 Project	0-0-3

ELECTIVE-II

- IME 721: Composite Materials
- IME 722: Mechanical Vibrations
- IME 723: Micro Manufacturing
- IME 724: Design of Thermal Systems
- IME 725: Non conventional Energy Resources and utilization
- IME 726: Maintenance Engineering and Management
- IME 727: Principles of Machine Tool Design

IME 701
COMPUTER AIDED MANUFACTURING

L:T:P
3: 1: 0

Unit 1

Introduction

Introduction to Automation. need and future of NC systems and CAM. Advantages & disadvantages. Historical development and future trends.

Features of NC Machines-

Difference between ordinary and NC machine tools. Methods for improving Accuracy and Productivity. Direct numerical control (DNC) and computer numerical control (CNC), adaptive control of manufacturing processes, Motion control in NC machine, designation of NC axes.

Unit 2

NC Part Programming

(a) Manual (word address format) programming, Preparatory codes, Miscellaneous codes, Examples: Turning, Drilling and Milling.

(b) APT programming. Geometry, Motion and Additional statements, Macro- statement.

Unit 3

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 Analyzers. Linear interpolator, circulator Interpolator.

Control of NC Systems- Open and closed loops. Automatic control of closed loops with encoder & tachometers. Speed variation of DC motor. Adaptive control.

Unit 4

Computer Integrated Manufacturing system- Introduction to Group Technology, Manufacturing cell, Transfer lines, FMS, CIM, CAD/CAM, CAPP, Concept of Mechatronics & MEMS.

Unit 5

Robotics- NC machine vs Robots. Types and generations of Robots. Robot applications. Economics, Robot programming methods. VAL and AML with examples.

Intelligent Manufacturing

Introduction to Artificial Intelligence for Intelligent manufacturing.

Books/References-

1. Computer control of manufacturing systems by Koren
2. NC Machines by Koren
3. CAD/CAM by M.P.Groover and E.W.Zimmer.
4. NC Machine Tools by S.J. Martin.
5. CAD/CAM Principles and applications by P.N. Rao
6. Automation, Production System and Computer Integrated Manufacturing, M P Groover, PHI

IME 702
REFRIGERATION & AIR CONDITIONING

L:T :P
3: 1: 0

Unit-1

Refrigeration:

Introduction to refrigeration system, Methods of refrigeration, Carnot refrigeration cycle, Unit of refrigeration, Refrigeration effect & C.O.P.

Air Refrigeration cycle:

Open and closed air refrigeration cycles, Reversed Carnot cycle, Bell Coleman or Reversed Joule air refrigeration cycle, Aircraft refrigeration system, Classification of aircraft refrigeration system. Boot strap refrigeration, Regenerative, Reduced ambient, Dry air rated temperature (DART).

Unit-2

Vapour Compression System:

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 of condensate & superheating of refrigerant vapour on C.O.P of the cycle, Actual vapour compression refrigeration cycle, Multistage vapour compression system requirement, Removal of flash gas, Intercooling, Different configuration of multistage system, Cascade system.

Unit-3

Vapour Absorption system;

Working Principal of vapour absorption refrigeration system, Comparison between absorption & compression systems, Elementary idea of refrigerant absorbent mixtures, Temperature – concentration diagram & Enthalpy – concentration diagram , Adiabatic mixing of two streams, Ammonia – Water vapour absorption system, Lithium- Bromide water vapour absorption system, Comparison.

Refrigerants:

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

Unit-4

Air Conditioning:

Introduction to air conditioning, Psychometric properties and their definitions, Psychometric chart, Different Psychome tric processes, Thermal analysis of human body, Effective temperature and comfort chart, Cooling and heating load calculations, Selection of inside & outside design conditions, Heat transfer through walls & roofs, Infiltration & ventilation, Internal heat gain, Sensible heat factor (SHF), By pass factor, Grand Sensible heat factor (GSHF), Apparatus dew point (ADP).

Unit-5

Refrigeration Equipment & Application:

Elementary knowledge of refrigeration & air conditioning equipments e.g compressors, condensers, evaporators & expansion devices, Air washers, Cooling, towers & humidifying efficiency, Food preservation, Cold storage, Refrigerates 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.

Books:

1. Refrigeration and Air conditioning, by Manohar Prasad, New Age International (P) Ltd.Pub.
2. Refrigeration and Air conditioning by C.P Arora.
3. Refrigeration and Air conditioning by Arora & Domkundwar.
4. Refrigeration and Air conditioning by Stoecker & Jones.
5. Refrigeration and Air conditioning by Roy J. Dossat.
6. Thermal Environment Engg. by Kuhen, Ramsey & Thelked.
7. Refrigeration and Air conditioning by R.C. Arora, PHI

IME 703
ADVANCED MANUFACTURING PROCESSES

L:T:P
3: 1:0

Unit-I

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

Unit II

Mechanical Processes: Principle, working, analysis and applications of unconventional machining process such as Ultrasonic machining, Abrasive jet machining, Abrasive flow machining, Magnetic abrasive finishing

Unit - III

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

Unit IV

Chemical based process: Electrochemical machining, Chemical machining,
Unconventional welding processes: Explosive welding, Cladding etc, under water welding, Metallising, Plasma arc welding/cutting etc.

Unit V

Unconventional Forming Processes : Principle, working and application of High energy forming processes such as Explosive Forming, Electromagnetic forming, Electro-discharge forming, water hammer forming, explosive compaction etc., Hybrid machining,ProCAM, ECDM, EDDG etc. Introduction to micromanufacturing.

Books

1 Advanced Machining Processes – V.K. Jain
2 Modern Machining Processes – P.C. Pandey

IME 751
CAD/CAM LAB

L-T-P
0-0-2

CAD Experiments-

1. Transformations algorithm experiment for translation/rotation/scaling: writing program and running it on computer.

2. 2DGeometry drawing algorithm experiment e.g. for straight line and circle: writing the program and running it on computer.

3. 2DGeometry drawing algorithm experiment e.g. for Bezier curves, B-Spline curves and circle: writing the program and running it on computer

4. Design problem experiment: writing the program for design of machine element or other system and running it on computer.

5. Optimization problem experiment: writing a program for optimizing a function and running it on computer.

6. Study of types of modeling e.g. wire frame, B-Rep etc.

7. Computer Aided Drafting: understanding and use of available CAD package commands, 3D drawing.

8. Writing a small program for FEM for 2 spring system and running it. or using a FEM package.

B. CAM experiments-

1. Writing a part-programming (in word address format or in APT) for a job for drilling operation (point-to-point) and running on NC machine.

2. Writing a part programming (in word address format or in APT) for a job for milling operation (contouring) and other available functions and running on NC machine

3. Writing a part programming (in word address format or in APT) for a job for turning operations and running it on NC machine.

4. Study of difference between ordinary machine and NC machine.

5. Study of system devices such as motors and feed back devices.

Minimum 8 experiments (at least 4 from each group)

IME 752
REFRIGERATION & AIR CONDITIONING LAB

L T P
0 0 2

Minimum 8 experiments out of following;

1. Experiment on refrigeration test rig 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 different types of condensers.

5. To study basic components of air-conditioning system.

6. Experiment on air-conditioning test rig & calculation of various performance parameters.

7. To study air washers

8. Study of window air conditioner.

9. Experiment on Ice-plant.

10. Study of Hermetically sealed compressor.

11. Experiment on Desert coolers.

VISIT : Visit of a central air conditioning plant / cold-storage and its detailed study.

ELECTIVE II

IME 721
COMPOSITE MATERIALS

L:T:P
3:1: 0

Unit I

Introduction: Definition, Characteristics classification Particulate and fibrous composites

Fibers Matrices and Fabrication of Composites: Advance fibers, Glass fibers carbon and graphite fibers Aramid fibers Boron Fibers and other fibers. Matrix materials: Polymer and Metals, Fabrication of composites.

Unit II

Behavior of unidirectional composites : Nomenclatures, volume and weight fractions, Longitudinal Strength and Stiffness, Transverse Stiffness and Strength, Prediction of shear and Poisson Ratio, Failure modes,

Short Fiber Composites Theries of stress transfer Modulus and Strength of Short fiber

Unit III

Analysis of an orthotropic Lamina : Hookes law for orthotropic Materials, Stress- strain Relations and engineering Constants, Strength of an Orthotropic Lamina

Unit IV

Analysis of Laminated Composites : Strain and stress Variation in a laminate, Synthesis of Stiffness Matrix, Construction and Properties of Special Laminates, Dtermination of laminae stress and strains, Analysis of laminates after initial failure. Hygro-thermal stresses in Laminates.

Unit V

Experimental Characterization of Composites Uniaxial Tension test, Uniaxial Compression Test, Inplane Shear test , Uniaxial Bending Tests Determination of Interlaminar Shear Strength and Fracture toughness. Damage Identification Using Nondestructive Evaluation Techniques

Books

1. Analysis and Performanc e of fiber composite by Agrawal, B.D., Broutman L.J., John Wiley & Sons Inc.
2. Introduction to composite Materials by Tsai S.W., Hahn H.T., Thechnomic West Port, Conn.
3. Primer on Composite Material Analyisis, Haplin J.C., Technomic Stanford, Conn.1984
4. Mechanics of composite materials, Jones R.M., Sripta Book Company Washington D.C.

IME 722
MECHANICAL VIBRATION

L:T:P
3: 1: 0

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

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.

Reference Books :

1. Church A.H. "Mechanical Vibrations"
2. Thomson, W.T. "Vibration Theory and Applicationos" by Prentice Hall
3. Grover, G.K. "Mechanical Vibrations" Nem Chand Publishers, Roorkee
4. Rao S.S. "Mechanical Vibrations" Addison-Wesley
5. Mechanical Vibrations by Tse, Morse and Hinkle, Prentice-Hall.

IME 723
Micromanufacturing Processes

L:T:P
3: 1: 0

I Introduction

Micromanufacturing: An Introduction
Challenges in Meso-, Micro-, and Nanomanufacturing

II Micromachining

Traditional Micromachining

Microturning
Microgrinding

Advanced Micromachining

Biomachining – Acidithiobacillus-Genus-Based Metal Removal
Micro- and Nanomanufacturing by Focused Ion Beam

III Nanofinishing

Magnetorheological and Allied Finishing Processes
Magnetic Abrasive Finishing (MAF)
Abrasive Flow Finishing (AFF) for Micromanufacturing

IV Microjoining

Laser Microwelding
Electron Beams for Macro- and Microwelding Applications

V Microforming

Micro- and Nanostructured Surface Development by Nano Plastic
Forming and Roller Imprinting
Microextrusion
Microbending with Laser

VI Miscellaneous

Dimensional Metrology for Micro/Mesoscale Manufacturing
Micromolding-A Soft Lithography Technique
Fabrication of Microelectronic Devices
An Integrated Wafer Surface Evolution Model for Chemical Mechanical Planarization (CMP)

Books:

1. Micromanufacturing Processes Edited by V.K. Jain, CRC Press, T&F Group
2. Introduction to Micromachining Editor V.K. Jain, Narosa Publ. House, New Delhi

IME 724
DESIGN OF THERMAL SYSTEMS

L :T:P
3 :1 :0

Unit-I

Psychrometry of Air Conditioning Processes, Design Conditions & Load Calculations Psychrometric Processes in Air Conditioning Equipments, Analysis of Air Conditioning systems for summer & winter conditions, Inside & outside design conditions for comfort, Industrial Air Conditioning.

Cooling & Heating Load calculations- Heat transfer through building structures, solar heat gain, Infiltration & ventilation air, Internal heat gain, Occupancy & Product load, Room sensible heat factor, Effective sensible heat factor & Grand sensible heat factor, capacity of the plant.

Design & Selection of Air conditioning Apparatus

Heat & moisture transfer in Air conditioning apparatus, Enthalpy potential, Analysis of Coil & Spray Equipments Design of Cooling & Dehumidifying coils, Design of Air Washer & Cooling Towers.

Unit-II

Analysis of Complete Vapour Compression System – Design and Balancing of System Components Type of Refrigerant Compressors, Condensers, Evaporators & Expansion devices used in Vapour Compression Refrigeration Cycles, Design and Selection of individual components and their performance characteristics, Use of P-H charts for different Refrigerants in performance predication of the cycle. Analysis of the complete vapour-compression-system and determination of 'Balance Points' using Graphical and Analytical methods, system simulation. Layout & selection of Refrigerant, water and Brine pipings for the designed system. Selection of Refrigeration and Air conditioning Controls for the system.

Unit-III

Design of Turbomachines: Principles of Design of turbo machines, Design of axial flow turbine stage, Design of axial flow compressor stage, Design of centrifugal compressor.

Unit-IV

Design of Heat Exchanger : Study of design aspects, fluid flow and heat transfer characteristics, Material requirement of heat exchange equipments, Liquid – to liquid and Liquid – to – gas heat exchange systems, Familiarity with use of design related standards and codes, Design of Heat exchanger.

Unit-V

Optimization of design of thermal systems like condenser, evaporator, cooling tower for minimum cost and maximum performance, Development of computer program for design, Environmental consideration in design of thermal systems, Analysis of thermal systems using FEM.

References

1. Refrigeration & Air Conditioning - By C.P. Arora
2. Refrigeration & Air Conditioning - By Manohar Prasad
3. Principles of Refrigeration (S.I.Units) - By Roy J.Dossat
4. Air Conditioning Engineering - By W,P.Jones
5. Heating, Ventilating and Air Conditioning - By Mc Quistion, Parker & Spitler
6. Refrigeration & Air Conditioning Data Book – Manohar Prasad
7. Ashrae hand Book – Fundamentals

IME 725
NON-CONVENTIONAL ENERGY RESOURCES AND UTILISATION

L:T:P
3: 1: 0

UNIT-1

Energy resources and their utilization:

Indian and global energy sources, Energy exploited, Energy planning, Energy parameters (energy intensity, energy-GDP elasticity), Introduction to various sources of energy, Solar thermal, Photovoltaic, Water power, Wind energy, Biomass, Ocean thermal, Tidal and wave energy, Geothermal energy, Hydrogen energy systems, Fuel cells, Decentralized and dispersed generation.

Solar radiations:

Extra terrestrial radiation, Spectral distribution, Solar constant, Solar radiations on earth, Measurement of solar radiations, Solar radiation geometry, Flux on a plane surface, Latitude, Declination angle, Surface azimuth angle, Hour angle, Zenith angle, Solar altitude angle expression for angle between incident beam and the normal to a plane surface (no derivation), Local apparent time, Apparent motion of sun, Day length, Solar radiation data for India.

UNIT-2

Solar energy:

Solar thermal power and it's conversion, Solar collectors, Flat plate, Performance analysis of flat plate collector, Solar concentrating collectors, Types of concentrating collectors,Thermodynamic limits to concentration, Cylindrical collectors, Thermal analysis of solar collectors, Tracking CPC and solar swing .

Solar thermal energy storage, Different systems, Solar pond.
Applications, Water heating, Space heating & cooling, Solar distillation, solar pumping, solar cooking, Greenhouses, Solar power plants.

Solar photovoltaic system:

Photovoltaic effect, Efficiency of solar cells, Semiconductor materials for solar cells, Solar photovoltaic system, Standards of solar photovoltaic system, Applications of PV system, PV hybrid system.

UNIT-3

Biogas:

Photosynthesis, Bio gas production Aerobic and anaerobic bio-conversion process, Raw materials, Properties of bio gas, Producer gas, Transportation of bio gas, bio gas plant technology & status, Community biogas plants, Problems involved in bio gas production, Bio gas applications, Biomass conversion techniques, Biomass gasification, Energy recovery from urban waste, Power generation from liquid waste, Biomass cogeneration, Energy plantation, Fuel properties, Biomass resource development in India.

Wind energy:

Properties of wind, Availability of wind energy in India, wind velocity, Wind machine fundamentals, Types of wind machines and their characteristics, Horizontal and Vertical axis wind mills, Elementary design principles, Coefficient of performance of a wind mill rotor, Aerodynamic considerations in wind mill design, Selection of a wind mill, Wind energy farms, Economic issues, Recent development.

UNIT-4

Electrochemical effects and fuel cells:

Principle of operation of an acidic fuel cell, Reusable cells, Ideal fuel cells, Othe r types of fuel cells, Comparison between acidic and alkaline hydrogen-oxygen fuel cells, Efficiency and EMF of fuel cells, Operating characteristics of fuel cells, Advantages of fuel cell power plants, Future potential of fuel cells.

Tidal power:

Tides and waves as sources of energy, Fundamentals of tidal power, Use of tidal energy

Limitations of tidal energy conversion systems.

Hydrogen Energy:

Properties of hydrogen in respect of its use as source of renewable energy, Sources of hydrogen, Production of hydrogen, Storage and transportation, Problems with hydrogen as fuel, Development of hydrogen cartridge, Economics of hydrogen fuel and its use.

UNIT-5

Thermoelectric systems:

Kelvin relations, power generation, Properties of thermoelectric materials, Fusion Plasma generators.

Geothermal energy:

Structure of earth's interior, Geothermal sites, earthquakes & volcanoes, Geothermal resources, Hot springs, Steam ejection, Principal of working, Types of geothermal station with schematic representation, Site selection for geothermal power plants. Advanced concepts, Problems associated with geothermal conversion.

Ocean energy;

Principle of ocean thermal energy conversion, Wave energy conversion machines, Power plants based on ocean energy, Problems associated with ocean thermal energy conversion systems, Thermoelectric OTEC, Developments of OTEC, Economics .

Impact of renewable energy generation on environment, Kyoto Protocol, Cost of electricity production from different energy sources, Energy options for Indian economy.

Books / Reference:

Bansal Keemann, Meliss," Renewable energy sources and conversion technology", Tata Mc Graw Hill.

Kothari D.P., "Renewable energy resources and emerging technologies", Prentice Hall of India Pvt. Ltd.

Rai G.D, "Non-Conventional energy Sources", Khanna Publishers.

Ashok V. Desai, "Nonconventional Energy", New Age International Publishers Ltd.

IME 726
MAINTENANCE ENGINEERING & MANAGEMENT

L:T:P
3: 1: 0

Unit-I

Introduction, operating life cycle, reliability, Failure data analysis, failure rate curve, hazard models, elements in series, parallel, mix, logic diagrams, improving reliability, redundancy element, unit, standby, maintainability, availability, reliability and maintainability trade off.

Unit-II

Maintenance Strategies: Break down maintenance, planned maintenance, strategies, preventive maintenance, design out maintenance, planned lubrication, total productive maintenance, zero break down, preventive inspection of equipment used in emergency.

Unit-III

Replacement planning maintain or replace decision, replacement of items that deteriorate identical equipment, replacement of items that fail without deterioration individual, group replacement, replacement in anticipation of failure.

Unit-IV

Break down maintenance planning, assignment model, waiting time models expected waiting time, minimum cost service rate, PERT.

Unit-V

Maintenance Management, production maintenance system, objectives and functions, forms, policy, planning, organization, economics of maintenance, manpower planning, materials planning, spare parts planning and control, evaluation of maintenance management.

Books:

1. Management of systems – R.N. Nauhria & R. Prakash.
2. Operations Research – Wangner.

IME 727
PRINCIPLES OF MACHINE TOOL DESIGN

L:T:P
3: 1: 0

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.

Books :

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.

\

IOE 741 OPEN ELECTIVE (TO BE OFFERED BY MED)

NON-CONVENTIONAL ENERGY RESOURCES AND UTILISATION

L:T:P
3: 1: 0

UNIT-1

Energy resources and their utilization:

Indian and global energy sources, Energy exploited, Energy planning, Energy parameters (energy intensity, energy-GDP elasticity), Introduction to various sources of energy, Solar thermal, Photovoltaic, Water power, Wind energy, Biomass, Ocean thermal, Tidal and wave energy, Geothermal energy, Hydrogen energy systems, Fuel cells, Decentralized and dispersed generation.

Solar radiations:

Extra terrestrial radiation, Spectral distribution, Solar constant, Solar radiations on earth, Measurement of solar radiations, Solar radiation geometry, Flux on a plane surface, Latitude, Declination angle, Surface azimuth angle, Hour angle, Zenith angle, Solar altitude angle expression for angle between incident beam and the normal to a plane surface (no derivation), Local apparent time, Apparent motion of sun, Day length, Solar radiation data for India.

UNIT-2

Solar energy:

Solar thermal power and it's conversion, Solar collectors, Flat plate, Performance analysis of flat plate collector, Solar concentrating collectors, Types of concentrating collectors,Thermodynamic limits to concentration, Cylindrical collectors, Thermal analysis of solar collectors, Tracking CPC and solar swing .

Solar thermal energy storage, Different systems, Solar pond.
Applications, Water heating, Space heating & cooling, Solar distillation, solar pumping, solar cooking, Greenhouses, Solar power plants.

Solar photovoltaic system:

Photovoltaic effect, Efficiency of solar cells, Semiconductor materials for solar cells, Solar photovoltaic system, Standards of solar photovoltaic system, Applications of PV system, PV hybrid system.

UNIT-3

Biogas:

Photosynthesis, Bio gas production Aerobic and anaerobic bio-conversion process, Raw materials, Properties of bio gas, Producer gas, Transportation of bio gas, bio gas plant technology & status, Community biogas plants, Problems involved in bio gas production, Bio gas applications, Biomass conversion techniques, Biomass gasification, Energy recovery from urban waste, Power generation from liquid waste, Biomass cogeneration, Energy plantation, Fuel properties, Biomass resource development in India.

Wind energy:

Properties of wind, Availability of wind energy in India, wind velocity, Wind machine fundamentals, Types of wind machines and their characteristics, Horizontal and Vertical axis wind mills, Elementary design principles, Coefficient of performance of a wind mill rotor, Aerodynamic considerations in wind mill design, Selection of a wind mill, Wind energy farms, Economic issues, Recent development.

UNIT-4

Electrochemical effects and fuel cells:

Principle of operation of an acidic fuel cell, Reusable cells, Ideal fuel cells, Othe r types of fuel cells, Comparison between acidic and alkaline hydrogen-oxygen fuel cells, Efficiency and EMF of fuel cells, Operating characteristics of fuel cells, Advantages of fuel cell power plants, Future potential of fuel cells.

Tidal power:

Tides and waves as sources of energy, Fundamentals of tidal power, Use of tidal energy Limitations of tidal energy conversion systems.

Hydrogen Energy:

Properties of hydrogen in respect of its use as source of renewable energy, Sources of hydrogen, Production of hydrogen, Storage and transportation, Problems with hydrogen as fuel, Development of hydrogen cartridge, Economics of hydrogen fuel and its use.

UNIT-5

Thermoelectric systems:

Kelvin relations, power generation, Properties of thermoelectric materials, Fusion Plasma generators.

Geothermal energy:

Structure of earth's interior, Geothermal sites, earthquakes & volcanoes, Geothermal resources, Hot springs, Steam ejection, Principal of working, Types of geothermal station with schematic representation, Site selection for geothermal power plants. Advanced concepts, Problems associated with geothermal conversion.

Ocean energy;

Principle of ocean thermal energy conversion, Wave energy conversion machines, Power plants based on ocean energy, Problems associated with ocean thermal energy conversion systems, Thermoelectric OTEC, Developments of OTEC, Economics .

Impact of renewable energy generation on environment, Kyoto Protocol, Cost of electricity production from different energy sources, Energy options for Indian economy.

Books / Reference:

Bansal Keemann, Meliss," Renewable energy sources and conversion technology", Tata Mc Graw Hill.

Kothari D.P., "Renewable energy resources and emerging technologies", Prentice Hall of India Pvt. Ltd.

Rai G.D, "Non-Conventional energy Sources", Khanna Publishers.

Ashok V. Desai, "Nonconventional Energy", New Age International Publishers Ltd.

Semester VIII

S/No.	Title of Theory Course	L-T-P
1	IME 801 Automobile Engineering	3-1-0
2	IME 802 Operations Research	3-1-0
3	ELECTIVE – III (IME-831 to 838)	3-1-0
4	ELECTIVE – IV (IME-841 to 848)	3-1-0
	Lab Course	
1	IME 851 Automobile Engineering Lab	0-0-2
2	IME 852 Project	0-0-12

ELECTIVE III	ELECTIVE IV
• IME 831: Pressure Vessel Design • IME 832: Finite Element Method • IME 833: Non Destructive Evaluation • IME 834: Solar Energy • IME 835: Thermal Turbo Machines • IME 836: Metal Forming • IME 837: Introduction to Robotics • IME 838: Optimization Methods in Engineering	• IME 841: Rapid Prototyping and Rapid Tooling • IME 842: Experimental Stress Analysis • IME 843: Bearings and Lubrication • IME 844: Energy Management • IME 845: Power Plant Engineering • IME 846: Computer Integrated Manufacturing Systems • IME 847: Operations Management • IME 848: Advanced Welding Technology

IME 801
AUTOMOBILE ENGINEERING

L:T:P
3: 1: 0

Unit I

Automobile and society, Scope of the course and automobile industries, Engine classification, Basic engine terminology. Automobile chassis, Main and sub frames, chassis lubrication, bodyalignment and instruments used.

Unit II

Car body, springs and dampers. Suspension system for front and rear wheels, shock absorbers. Brakes; Function and methods of braking, types of brakes; Semi servo brakes, servo and power operated braking systems and hydraulic mechanism.

Unit III

Steering mechanisms; power steering, front axle steering mechanism and working. Front end geometry and alignment Caster and camber angles king-pin inclination, too- in and too-out. Cam and lever steering gear, Steering geometry, Ackerman's principle.

Unit IV

Transmission requirements; clutches of various types like friction, centrifugal, magnetic etc. Types of transmissions levers, Linkages etc. Fluid couplings.

Gear Box: Function of gear box and determination of overall gear ratios, synchronous, epicyclic and pre selector gear box, Torque converters.

Universal joint and its purpose; Differential, Front and rear axles, Rear drive shafts and operation, Front wheel drive system.

Unit V

Vehicle dynamics, Air, Gradient and rolling resistance, total resistance, Variation of attractive efforts with speed, constant power tractive effort and maximum engine horse power curves against speed.

Pollution in our society, Types of pollutants, controlling pollution, and Road performance

Books:

1.The motor vehicle by Newton & W. Steeds
2.Automotive Mechanic By R. Crouse and D.L. Anglin
3.Automotive Chassis & Body by W.H. Crouse
4.Automotive Mechanics by Anthony E. Schwalle

IME 802
OPERATIONS RESEARCH

L: T: P
3: 1: 0

Unit-I

Linear Programming-

Introduction & Scope, Problem formulation, Simplex methods, primal & dual problem sensitivity analysis.

Unit-II

Transportation & Assignment problems.

Dynamic Programming-

Multistage decision problems & solution, Principle of optimality.

Unit-III

Decision theory -

Decision under various conditions.

Game Theory-

Minimax & maximum strategies. Application of linear programming.

Unit-IV

Stochastic inventory models-

Single & multi period models with continuous & discrete demands, Service level & reorder policy

Unit-V

Simulations -

Simulation V/S mathematical modeling, Monte carlo simulation, simulation languages, Example & cases.

Queing models-

Introduction Model types, M.M. 1 & M/M/S system cost consideration

Text Books

1. Operations Research by : Wangner
2. Production Planning of Operation Management : by Buffa.
3. Optimization Techniques by : S.S. Rao.
4. Operations Research by : Taha

IME 851
AUTOMOBILE ENGINEERING LAB

L:T: P
0: 0: 2

1. Study of braking systems & experiment on vacuum brake.

2. Study of steering systems & experiment on power steering.

3. Study on lubrication and cooling system.

4. Study on five speed gear box and differential gear box.

6. Study of cut section model of multi cylinder petrol and diesel engine.

7. Study of fuel supply system for petrol and diesel engine.

8. Study of front and rear axle assembly.

9. Comparative study of features of common small cars (such as fiat, Ambassador, Maruti, Matiz, Santro, Indica and its variations) available in India.

10. Comparative study of technical features of common scooters & motorcycles available in India.

11. Comparative Study of Technical features of common heavy vehicles available in India.

12. Visit of an Automobile factory.

Note: - Other experiments can be taken up subject to availability of its experimental set ups. Minimum 8 experiments

Elective III

IME 831
PRESSURE VESSEL DESIGN

L:T:P
3: 1:0

UNIT-1 Introduction to the subject, Preliminary considerations., Design considerations and salient features.
UNIT-2 Thin pressure vessels.
UNIT-3 Thick pressure vessels. Jacketed cylinders. Wire-wound vessels. Prestressing and autofrettage. Ends and openings in vessels. Compensated openings.
UNIT-4 Design of pipes. Material selection and fabrication methods. Design of a boiler shell. IBR. Welded and riveted consternation. Pressure vessel testing and inspection. NDT
UNIT-5 Design of high pressure vessels for Oil and Gas. Failure modes- case studies
Books:
1.Pressure Vessel Design by Harvey.
2.Pressure Vessel Design Handbook by Bednar.
3.Strength of Materials.
4.Machine Design by Dr. S. Singh

IME 832
FINITE ELEMENT METHOD

L:T:P
3: 1:0

UNIT-1

Fundamental Concepts: Introduction, Historical Background, FEM/FDM/Mesh free Methods, Stresses and Equilibrium, Boundary Conditions, Strain Displacement Relations, Stress-Strain Relations, Rayleigh-Ritz Method, Galerkin Method, Saint Venant's Principle. MatrixAlgebra: Basic Matrix Operations, Basic Types of Matrices, Eigenvalues and Eigenvectors

UNIT-2

One Dimensional Problems: Finite element Modeling, Coordinates and Shape Functions, Potential Energy Approach, Galerkin Approach, Assembly of the Global Stiffness Matrix and Load Vector

UNIT-3

Two Dimensional Problems: Finite Element Modeling, Constant Strain Triangle (CST), Problem Modeling and Boundary Conditions, Axisymmetric Solids subjected to Axisymmetric Loading: Axisymmetric Formulation,

UNIT-4

Finite Element Modeling: Triangular Element, Problem Modeling and Boundary, Conditions, Two-Dimensional Isoparametric Elements: Four-Node Quadrilateral, Numerical, Integration, Higher-Order Elements,

UNIT-5

Scalar Field Problems: Steady-State Heat Transfer, Torsion, Potential Flow, Electric and Magnetic Fields, Dynamic Analysis: Formulation, Element Mass Matrices, Evaluation of Eigen values and Eigenvectors, Overview of a Commercial Finite Element Code: ANSYS

Books:

1. Introduction to Finite Elements in Engineering by T.R. Chandrupatla and A.D. Belegundu, Prentice- Hall of India

Reference Books:

1. Finite Element Procedures in Engineering Analysis by K.J. Bathe, Englewood Cliffs, Prentice Hall
2. Concepts and Applications of Finite Element Analysis by R.D. Cook, Wiley
3. Introduction to the Finite Element Method by C.S. Desai and J.F. Abel, Van Nostrand Reinhold
4. The Finite Element Method - Linear Static and Dynamic Finite Element Analysis by T.J.R. Hughes, Englewood Cliffs, Prentice-Hall
5. The Finite Element Method in Engineering by S.S. Rao, Pergamon.
6. An Introduction to the Finite Element Method by J.N. Reddy, McGraw-Hill
7. An Analysis of the Finite Element Method by G. Strang and G.J. Fix, Englewood Cliffs, Prentice Hall
8. The Finite Element Method by O.C, Zienkiewicz, McGraw-Hill

IME 833
NON DESTRUCTIVE EVALUATION

L:T:P
3: 1:0

Unit I

Destructive vs Non Destructive Evaluation, Factors to consider in selecting tests, Economics of testing, In service testing.

Defect detection, Terminology for non-destructive evaluation – Discontinuity, Imperfections, Flaw, Defects, Non-critical flaw, critical flaw, False vs. relevant indications. Interpretation and evaluation.

Unit II

Methods of Non destructive evaluation, Visual Inspection, Surface Inspection Methods, Dye penetrant method, Eddy current testing, Magnetic testing methods, Ultrasonic testing, Acoustic Emission. Radiography, X-ray.

Unit III

Eddy Current Testing- Basics of Eddy current testing, factors affecting eddy current response. Magnetic testing methods- Magnetization curves and hysterises, Magnetic particle tests, scope of test, detection of flaws and cracks using magnetic flux leakage.

Radiographic Testing Methods: Principle, equipment and methodology, X-ray images, radiographic film, properties of x-ray film.

Unit IV

Ultrasonic Testing: Generation of ultrasounds in materials, Transducers, Display and interpretation of ultrasonic data. Princ iple of operation, Ultrasonic probes, Advantages, Limitation and Typical applications.

Unit V

Thermography: Principle and application, Acoustic emission technique, Basics and applications. Real Time Evaluation: Concept of Smart Structures

Reference Books:

1. Introduction to the Principles of Material Evaluation by David C Jiles, CRC Press.

2. Evaluation of Material & Structures by Quantitative Ultrasonics, by J.D. Achenbach, Springer-Verlag, New York-1994

3. Ultrasonic methods of Non destructive testing by J. Blitz and G. Simpson, Chapman & Hall London, 1995.

4. Industrial Radiology: Theory & Practices by R. Halmshaw, Chapman & Hall, London, 1995.

IME 834
SOLAR ENERGY

L: T: P
3: 1: 0

UNIT-1
Introduction, Energy alternative, Devices for thermal collection and storage, Thermal applications.
Solar radiation: Instruments for measuring solar radiation, Solar radiation geometry, Empirical equations for prediction the availability of solar radiation, Solar radiation on tilted surfaces.

UNIT-2
Liquid flat- Plate Collectors: General performance analysis, Transmissivityabsorptivity product and overall loss coefficient and heat trasfer correlations, Collector efficiency factor, Numericals,
Analysis of collectors similar to the conventional collector. Testing procedures, Alternatives to the conventional collector, Numericals.

UNIT-3
Solar Air Heaters: Performance analysis of a conventional air heater, Other types of air heaters.
Concentrating Collectors: Flat plate collectors with plane reflectors, Cylindrical parabolic collector, Compound parabolic dish collector ,Central receiver collector, Numericals.

UNIT-4
Thermal energy storage: Sensible heat storage, Latent heat Storage, Thermo-chemical storage .
Solar distillation: Introduction, working principal of solar distillation, Thermal efficiency of distiller unit, External heat transfer, Top loss coefficient, Bottom and side loss coefficient, Internal heat transfer, Radioactive loss coefficient, connective loss coefficient, Evaporative loss coefficient, Overall heat Evaluation of distillation output, Passive solar stills, Conventional solar still, Basin construction, Thermal analysis of conventional solar still.

UNIT-5
Photovoltaic Systems: Introduction doping Fermi level, P-N junction characteristics, Photovoltaic effect, Photovoltaic material, Module, Cell temperature, Numericals.
Economic analysis: Introduction, cost analysis.

BOOKS:
Solar Energy: Thermal Processes, by Duffie John A, and Beckman W.A, john Wiley and Sons.
Solar Energy, by S.P Sukhatme, Tata Mc Graw Hill.
Treatise on Solar Energy, by H.P Garg, john Wiley and Sons.

IME 835
THERMAL TURBOMACHINES

L:T:P
3: 1: 0

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, Definition of various efficiencies, Preheat factor, Reheat factor, Blade classification, Blade terminology, Cascade testing, Velocity diagrams for axial and radial turbo machinery and pumps.

UNIT-II

Centrifugal compressors - Principle of operation, work done and pressure rise, Velcoity diagram for centrifugal compressor, Slip factor, Stage pressure rise, Loading coefficient, Diffuser, degree of reaction, Effect of impeller blade profile, Pre-whirl and inlet guide vanes, Centrifugal Compressor characteristic curves.

Axial flow compressor- Principle of operation and working, Energy transfer, Velocity diagram for axial compressor, Factors affecting stage pressure ratio, Blockage in compressor annulus, Degree of reaction, 3-D flow, Design process, blade design, calculation of stage performance, Axial compressor performance characteristic curves.

UNIT-III

Axial flow turbines-Elementary theory of axial flow turbine, Energy transfer, Velocity diagram, Types of blades, Vortex theory, Choice of blade profile, pitch and chord, Estimation of stage performance, Characteristic curves.

UNIT-IV

Steam turbines- Constructional details, working of steam turbine.

Pumps : Classification of Pumps, Main components, indicator diagram and modification due to piston acceleration, Performance characteristics, Cavitation and its control, Miscellaneous types of pumps.

Radial flow turbines: Elementary theory of radial flow turbines, Enthalpy- Entropy diagram, State losses, Estimation of stage performance, Performance characteristics.

UNIT-V

Gas Turbine Starting & Control Systems : Starting ignition system, Combustion system types, Safety limits & control.

Turbine Blade coding: Different cooling techniques, Types of coolants, Comparative evaluation of different cooling techniques.

Mechanical Design consideration: Overall design choices, Material selection, Design with traditional materials.

Books

1. Gas turbine theory : Cohen & Rogers, Addison Weslay Longman Ltd.
2. Design of high efficiency turbomachinery and gas turbines, David Gordon Wilson, Theodosios 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 Hill.

IME 836
METAL FORMING

L:T:P
3: 1: 0

Unit1
Classification of Metal Forming Processes: Elementary theory of plasticity, stress / strain / strain rate characteristics of materials, yield criteria of metals, formability. Fundamentals of plasticity, yield and flow, anisotropy, instability, limit analysis, slip line field theory. Applications to forging, wire and tube drawing, deep drawing, extrusion and rolling.

Unit 2
Mechanics of Forming Process: Rolling, process parameters, pressure distribution and roll separating force, rolling pressure, driving torque and power requirements.
Forging: Determination of forces in strip forging and disc forging, defects in forged components.

Unit 3
Drawing: Drawing stresses, limiting draw ratio, factors affecting drawability determination of force and power in wire drawing, determination of maximum allowable reduction, deep drawing force analysis, defects in drawn components
Extrusion: Process, parameters, determination of work load from stress analysis and energy considerations, power loss, hydrostatic extrusion, pressure required to extrude, variables affecting the process
.

Unit 4
Bending: Bendability, determination of work load in bending process, spring back etc.
Punching & Blanking: Two-dimensional deformation model and fracture analysis, determination of working force.

Unit 5
High Energy Rate Forming: Classification, comparison of conventional and high speed forming, Introduction to High Energy Rate Forming Processes (HERF).

Books/References-
1. Engineering plasticity by Johnson and Mellor
2. Manufacturing Science by Amithabh Ghosh and V.P.Mullick
3. Production Engineering by PC Sharma
4. Plasticity Theory And Its Application In Metal Forming by V. Gopinath
5. Introduction to Engg. Plasticity by Lal, and Reddy, Narosa Pub.
6. Modeling Techniques for Me6tal forming Processes by Lal, Dixit and Reddy, Narosa Pub.

IME 837
INTRODUCTION TO ROBOTICS

L:T:P
3: 1: 0

Unit1

Introduction: Definition of a Robot, Economic aspects in robot applications w.r.t. quality and productivity. Robot classifications, Robot specifications, robot workspace envelope, motion accuracy and precision, type of end effectors etc.

Unit 2

Robot Kinematics: Homogeneous co-ordinates and co-ordinate transformations, D-H algorithm, Forward and inverse kinematics for multi axes axis revolute joint robots and SCARA robots.

Unit 3

Robot Dynamics: Introduction to La grange's and Newton-Euler formulations, and their application to dynamic considerations for velocity and acceleration of robot joints

Unit4

Trajectory planning : Joint space techniques, Cartesian space techniques.

Robot in Work Place: Work cell organization in robotics environment, Work Cell Design and Control.

Sensors and Vision: Tactile, Proximity and Range sensors in robots; Velocity sensors, Robot Vision. Introduction to image processing.

Unit5

Methods of Robot Programming: Introduction to on-line and off-line Robot programming methods

Applications of Robots: Welding, parts handling / transfer, assembly operations, parts sorting, parts inspection, future applications.

Books/References-

1. Fundamentals of Robotics, Analysis and Control by Robert J. Schilling
2. Introduction to robotics by John J. Craig
3. Robotics and Control by R.K.Mittal and I.J.Nagrath
4. Industrial Robotics-Technology, Programming and Application by M.P.Groover

IME 838
OPTIMIZATION METHODS IN ENGINEERING

L: T: P
3: 1: 0

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-Linar Programming, The Newton Algorithm, Non-Linear Least Squares, Sequential Quadratics Programming (SQP), Constrained Optimization, SQP Implementation, Multi-Objective Optimization, Branch and Bound Approaches, Genetic Agorthms 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 Mehtod and the Runge-Kutta Method for Ordinary Differential Equations, Gaussian Quardative Tranzoidal 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 Maximum 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, Transshipment Problems, Heuristic Methods.

Books.

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.
4. Williams H.P.: Model Building in Mathematics Programming.
5. Williams H.P.: Model Solving in Mathematics Programming
6. G.L. Nemhauser and L.A. Wolsey: Intger and Combinational Optimization.
7. R.G. Parker and R.L. Rardin:Discrete Optimization.
8. C.H. Papadimitrious and K. Stegilite: Combinational Optimization: Algorithms and Complexity

ELECTIVE IV

IME 841
RAPID PROTOTYPING AND RAPID TOOLING

L:T:P
3: 1: 0

Unit I

Introduction and fundamental to rapid Prototyping, Technology involved in Rapid Prototyping, Classifications of rapid Prototyping system. Rapid Prototyping Process chain, 3-D Modeling Data conversion and Trans mission Checking and Preparing, Building, Post Processing
Rapid Prototyping Data formats: STL Format and its Problem, STL File Repair, Newly Proposed Formats

Unit II

Liquid Based Rapid prototyping Systems: Streolithography Apparatus (SLA), Solid Ground Curing (SGC), Solid Creation System (SCS), Rapid Freeze Prototyping, Microfabrication

Unit III

Solid- Based Rapid prototyping systems: Laminated Object Manufacturing (LOM), Fused Deposition modeling (FDM), Paper Lamination Technology (PLT),
Powder Based rapid Prototyping Systems: Selective Laser Sintering Z-Corporation 3-D Printing (3DP), EOSINT Systems

Unit IV

Applications and Advantages of Rapid prototyping : Manufacturing and Tooling. Aerospace Industry., Automotive Industry, Biomedical Industry, Design, Jewelry.
of Rapid Prototyping,

Unit V

Advance Topics in Rapid Prototyping

Optimum part deposition orientation and algorithms, Adaptive slicing and algorithms.

Text Books

1. Rapid Prototyping : Principles and Applications by Chua C.K.,Leong K.F. and Lim C.S. World Scientific publications
2. Rapid Prototyping : Principles and Applications by Rafiq Noorani John Wiley
3. Laser-Induced Materials And Processes For Rapid Prototyping byLu,L.,Fuh,J. Y. H.&Wong,Y. S.
4. Rapid Prototyping Laser-Based And Other Technologies by Venuvinod, Patri K&Ma,Weiyin

IME 842
EXPERIMENTAL STRESS ANALYSIS

L:T:P
3: 1: 0

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 Coordinate 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 Photoelasticity.

Text Books:

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.
3. Experimental stress analysis by L.S.Srinath et. al.

IME 843
BEARINGS AND LUBRICATION

L:T:P
3: 1:0

UNIT-1
Introduction, Types of Lubricant, Types of Lubricants & their properties, Newtonian & Non-Newtonian models & Rheology

UNIT-2
Design of hydrodynamic Bearing. Reynolds Equation

UNIT-3
Design of hydrostatic Bearing, Restrictors & types and role in compensated Bearings, Flexible Bearing,

UNIT-4
Static characteristics of the bearing flow and Attitude angle, Dynamic characteristics of the bearing Threshold speed, frequency of whirl, entire journal Mass, Stiffness coefficient & damping coefficient.

UNIT-5
Gas bearing/MHD bearing, Hybrid bearing, Bearing materials.

Books:
1. Friction wear lubrication: A Text book in Tribology by Kenneth C Ludema, Oxford University Press
2. Introduction to Tribology by Bharat Bhushan, Elsevier Science
3. Heat, Bearings and Lubrication by Iris Florea, Springer Press

IME 844
ENERGY MANAGEMENT

L:T: P
3: 1:0

UNIT-1

Introduction to energy, Sources of energy, Forms of energy, Energy reserves, renewable energy sources, Unites of energy and the laws of thermodynamics,, Energy consumption and GDP, energy database , Energy demand analysis, Costs of exploration and utilization of depletable resources, energy pricing, National energy plan.

UNIT-2

Energy audit concepts, Energy audit based on 1st law and 2nd law of thermodynamics, Mass and Energy balances, Availability analysis, Evaluation of energy conserving opportunities, Economic analysis and life cycle costing.

UNIT-3

Energy conservation areas, Energy transmission and storage, Plant wide energy optimization Models, Data base for energy management , Energy conservation through controls, Computer aided energy management, Program organization and methodology.

UNIT-4

Electrical energy conservation in building lighting, heating, ventilating and air conditioning, Energy efficient motor, power factor improvement in power systems, Energy audit of Combustion process, Boilers, Turbines, compressors, Pumps, Heat exchangers, Condensers, Use of industrial, wastes.

UNIT-5

Energy environment interaction, Environmental issues, Global warning, Carbon dioxide emissions, Depletion of ozone layer, Government's regulations, Energy economy interaction.

BOOKS:

1. Energy Management and condevtion, by Clive Beggs, Butterwoth- Heinemann Elsevier Science.
2. Optimising Energy Efficiency in the Industry, By Rajan, Tata Mc Graw Hill Publishers.
3. Guide to energy Management , By C.L Capehart, Fairmont Press.
4. Renewable Energy Sources and their Environment Impact, by Abbasi & Abbasi, Prentice Hall of India.
5. Environmental Risks and Hazards by Cutter, Prentice Hall of India.
6. Energy and Power Risk Management: New Developments in Modeling, Pricing and Hedging, buy Alexander Eydeland, John Wiley & Sons.
7. Energy Management Handbook by, Wayne C. Turner.
8. Thermodynamics, By Kenneth Wark, Tata Mc Graw Hill Publishers.
9. Exergy Analysis of Thermal, Chemical and Metallurgical Process, By Jan Szargut, David R. Morris, Frank R. Steward, Hemisphere Pub, Springer Verlag Publisher

IME 845
POWER PLANT ENGINEERING

L:T: P
3:1:0

Unit-I

Introduction

Power and energy, sources of energy, review of thermodynamic cycles related to power plants, fuels and combustion calculations.

Load estimation, load curves, various terms and factors involved in power plant calculations. Effect of variable load on power plant operation, Selection of power plant units.

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

General layout of steam power plant, Power plant boilers including critical and super critical boilers. Fluidized bed boilers, boilers mountings and accessories, Different systems such as coal handling system, pulverizers and coal burners, combustion system, draft, ash handling system, Dust collection system, Feed water treatment and condenser and cooling towers and cooling ponds, 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, Site selection of a steam power plant.

Unit-III

Diesel power plant

General layout, Components of Diesel power plant, Performance of diesel power plant, fuel system, lubrication system, air intake and admission system, supercharging system, exhaust system, diesel plant operation and efficiency, heat balance, Site selection of diesel power plant, Comparative study of diesel power plant with steam power plant.

Gas turbine power plant

Layout of 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, Site selection of gas turbine power plant

Unit-IV

Nuclear power plant

Principles of nuclear energy, Lay out of nuclear power plant, Basic components of nuclear reactions, nuclear power station, Nuclear waste disposal, Site selection of nuclear power plants.

Hydro electric station

Hydrology, Principles of working, applications, site selection, classification and arrangements, hydro-electric plants, run off size of plant and choice of units, operation and maintenance, hydro systems, interconnected systems.

Non Conventional Power Plants

Introduction to non-conventional power plants (Solar, wind, geothermal, tidal) etc.

Unit-V

Electrical system

Generators and generator cooling, transformers and their cooling, bus bar,etc.

Instrumentation

Purpose, classification, selection and application, recorders and their use, listing of various control rooms.

Pollution

Pollution due to power generation

References

1. “Power Plant Engineering” F.T. Morse, Affiliated East-West Press Pvt. Ltd, New Delhi/Madras.
2. “Power Plant Engineering” Mahesh Verma, Metropolitan Book Company Pvt. Ltd. New Delhi.
3. “Power Plant Technology” El-Vakil, McGraw Hill.
4. Power Plant Engineering by P.K. Nag, Tata McGraw Hill.
Steam & Gas Turbines & Power Plant Engineering by R.Yadav, Central Pub.House.

IME 846
COMPUTER INTEGRATED MANUFACTURING SYSTEMS

L:T:P
3: 1: 0

Prerequisite: CAM

Unit 1

Introduction: Types of production systems and their automation. CAD/CAM integration. Concept of FMS and CIMS. Elements of a General CIM System: Types of CIM systems. CADCAM link for CIMS. Manufacturing data base in a CAD/CAM system. Benefits of CAM, FMS and CIMS. CIMS configurations: DNC based factory management and control, Integrated CAD/CAM system and shared database, Factories of the future. Impact of implementing CIMS on society, Introduction to rapid prototyping, and rapid tooling, concept of concurrent engineering. Reverse Engineering.

Unit 2

Automated material handling systems, equipment and their functions. Integration of Robots in CIMS, Automatic Storage and Retrieval Systems (AS/RS), Carousel. Palletization and fixtures. In process interfacing of storage with manufacture.

Group Technology: Concept and terminology, part family formation, classification and coding systems for components, Group Technology machine cells.

Unit 3

Computer Aided Process Planning: CAPP and route sheet development, CAPP system, Computer aided plant layout

Computer Aided Production Planning and Control: Inventory control and MRP, Computer aided cost estimation. Computer aided shop floor control, process monitoring. Computer aided Inspection & Quality Control, SQC, SPC. Use of 3D scanner as a QC tool

Unit 4

Networking: Introduction to fundamentals of computer communications, networking, computermachine-personnel communication links. Network architectures & techniques. Information flow in networks, network standards.

Unit 5

CIM Database and Database Management Systems: Types, Management Information System, Manufacturing data preparation. Shop floor data collection systems, shop floor control, sensors used, Tool management system, automatic identification systems, Barcode system. Product life cycle management.

Books/References

1. CAD/CAM by Zimmer and Groover.
2. Automation, production System and Computer Integrated Manufacturing by M.P.Groover
3. Principles Of Computer Integrated Manufacturing by S.Kant Vajpaee

IME 847
OPERATIONS MANAGEMENT

L:T:P
3: 1: 0

Unit-I : Production & Operations Strategy:
Production & Operation Strategy, Capacity growth planning, economics of scale & economics of scope, make or buy, dynamic capacity expansion, issues in plant location, learning curves, experience curves, learning & experience curves and manufacturing strategy, matching process & product life cycles, recent advances in manufacturing technology and control

Unit-II : Forecasting Methods & Aggregate Planning:
Time horizon in forecasting, characteristics of forecasts, subjective and objective forecasting methods, casual methods, time series methods, evaluating forecasts, methods for forecasting stationery series, exponent ional smoothing, methods for seasonal series. The aggregate planning problem, evaluation of chase strategy & constant work force plan, solution of aggregate problem as LP problem, linear decision rule, disaggregating the aggregate plan.

Unit-III : Inventory Control & MRP:
Inventory control subject to known demand, characteristics of inventory systems, relevant costs, the EOQ model with and with and without order lead time, EOQ & JIT, quantity discount model, resource constrained multiple product systems, inventory control subjected to uncertain demand, determining optimal policy. MRP: the explosion calculus, lot sizing schemes- heuristic lot sizing, incorporating lot-sizing algorithms into explosion calculus, use of MRP in real world.

Unit-IV : Operation Scheduling:
Characteristics of job shop scheduling problems, comparison of specific sequencing rules- FCFS, SPT, EDD, critical ratio. Theory of sequencing for single machine- with rules such as SPT, EDD, and minimum number of tardy jobs (NT). Minimizing the NT. Incorporating the precedence constraints. Sequencing algorithms for multiple machines- n jobs x 2 machines, extension to 3 machines, 2 job flow shop problem, stochastic scheduling- static analysis, vehicle scheduling & assembly line balancing.

Unit-V : Facility Layout & Location:
The facility layout problems, patterns of flow, activity relationship chart, from/to chart. Layout types, layout problem & assignment model, computerized layout planning techniques e.g. CRAFT, COFAD, ALDEP, CORLEP, PLANET etc. Locating new facilities, measures of distance, single facility, rectilinear distance problem, minimax problem, Euclidean distance problem, gravity problem, straight- line distance problem, locating multiple facilities.

Books:
1. Modern Production Operations Management by Elwood S Buffa, Rakesh K Sarin
2. Operations Management by Mcclain, John O.; Thomas, L. Joseph
3. Applied Production & Operations Management by Evans, James R
4. Production And Operations Management by Gaither, Norman

IME 848

ADVANCED WELDING TECHNOLOGY

L:T:P
3: 1: 0

Unit I

Introduction, Importance and application of welding, classification of welding processes, Selection of welding processes, Brief review of conventional welding processes: Gas welding, Arc welding, MIG, TIG welding, Resistance welding, Electro slag welding, Friction welding etc. Welding of MS, CI, Al, Stainless steel & Maurer ASchaefflar diagram, Soldering & Brazing.

Unit II

Advanced welding techniques – principle and 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, under water welding, Spray welding / Metallising, Hard facing.

Unit-IV

Welding Design: Welding Machines/Equipments and its characteristics and arc stability. Weld defects and distortions and its remedies, Inspection/testing of Welds, Weld Design, Welding of pipe – Lineness and pressure vessels, Life predication.

Unit-V

Thermal and metallurgical considerations: Thermal considerations for welding. Temperature distribution, Analytical/Empirical analysis formulae, heating & cooling curves. Metallurgical consideration of welding, HAZ and Parent metal, micro and macro structure, Solidification of weld and properties.

Books

1. Appreciation Course On Welding Technology, Parmar,R S,
2. A text book of Welding Technology by Kanna O.P.
3. Welding And Welding Technology by Little, Richard L
4. Principles Of Welding Technology, Gourd, L. M
5. Modern Welding Technology, Cary, Howard B.