ME302: ENGINEERING MECHANICS – II (3-1-3) (for EE, INS, CH)

Theory: 100 Sessional: 50 Laboratory: 50 Time: 3hours

1. Kinematics: Link, Pair, chain mechanism and inversions. Simple mechanism (description only), Crank slider, four bar, st. line, steering. Simple velocity and acceleration diagrams.
2. Machine elements:

a) Governor: functions, type expressions for height of watt and porter governors.
b) Flywheel: Fluctuations of energy, Co-efficient of fluctuation of energy and speed, function of flywheel.
c) Brake and Clutch: Working principles only. Simple problems illustrating use of above.

3. Balancing: Simple problems of rotary, primary unbalance, graphical solution.
4. Transmission of Rotary drive:

a) Belt and Rope Drive: Relations for torque, maximum power transmission, length of open cross belting slip, crowing of pulley.
b) Gear train: Nomenclature , types – simple, compound , epicyclic gear train including reverted gear train. Simple description of automobile gear train.

Laboratory: Six experiments covering the syllabus.

Books:

1.Theory of Machines by J. Lal , Metropolitan Books Ltd.
2. Theory of Machines and Mechanisms(3rd edition) by J.J.Uicker, Jr;G.R.Pennock & J.E.Shigley, Oxford University Press.
3. Theory of Machines by V.P.Singh,
4. Theory of Machines by A. Shariff

Note: See course structure about the branch(es) to which this paper is offered

ME 305: BASIC THERMODYNAMICS(3-1-0) (for ME, IP, EE, ET, INS,CH)

Theory: 100 Sessional: 50 Time: 3hours

System and Continuum:

Intensive and Extensive properties – Thermodynamic state, pressure, energy, work and heat – process and cycle – Macroscopic and Microscopic points of view – Kinetic theory of gases.

Laws of thermodynamics:

Zeroth law – Concept of equilibrium – Principles of thermometry – Fixed points.

First law of thermodynamics and its application to open and closed systems – Concept of internal energy – Steady flow energy equation – Processes of closed systems.

Second law of thermodynamics – Various statements – Carnot cycle – Irreversible and Irreversible processes – Thermodynamic efficiency and temperature scales – Concept of entropy – Entropy changes in various processes.

Properties of steam:

Latent heat – Saturation pressure and temperature – Dryness fraction – Degree of superheat – Total heat; Rankine cycles.

Air standard cycles:

Otto, Diesel – Principles of working and description of two and four stroke SI and CI engines – Representations of processes on T-S and p-v diagrams.

Fuels and Combustions: Classification of fuels; HCV, LCV, Bomb Calorimeter, Boy's gas calorimeter; Combustion of fuels; Minimum air required (by weight and by volume); Conversion of volumetric analysis into weight analysis and vice verse; excess air and Orsat apparatus.

Books:

1. Engineering thermodynamics by P K Nag, Tata McGraw Hill Publication
2. Fundamentals of Thermodynamics by Cengel and Boles, Tata McGraw Hill Publication
3. Fundamentals of Engineering Thermodynamics by E. Rathakrishnan, PHI

ME322: THEORY OF MACHINES 3-1-3) (for ME,IPE)

Theory: 100, Sessional: 50, Laboratory: 50, Time: 3hrs

1. Kinematics: Link, Pair, chain, mechanism and inversions. Simple mechanism (description only), Slider crank, four bar, straight line steering. Simple velocity and acceleration diagrams,
2. Strain energy, Virtual work, Introduction to vector approach.
3. Governor: Watt and porter governors. Spring controlled centrifugal governor – Hartnell, Hartung, Wilson –Hartnell, Inertia governors. Stability, Effects of friction, Isochronism, Hunting, effort and power.
4. Flywheel: Fluctuations of energy, Co-efficient of fluctuation of energy and speed, function of flywheel.
5. Brake and Clutch: Working principles only. Simple problems illustrating use of above.
6.Belt and Rope Drive: Relations for torque, maximum power transmission, length of open cross belting slip, crowning of pulley.
7. Gear and Gear train: Nomenclature, types – simple, compound , epicyclic gear train including reverted gear train. Simple description of automobile gear train.

Laboratory: Six experiments covering the syllabus.

Books: 1.Theory of Machines by J. Lal , Metropolitan Books Ltd.
2. Theory of Machines and Mechanisms(3rd edition) by J.J.Uicker, Jr;G.R.Pennock & J.E.Shigley, Oxford University Press.
3. Theory of Machines by V.P.Singh,
4. Theory of Machines by A. Shariff

ME 323: ENGINEERING GRAPHICS – III (1-0-6) (for ME,IPE)

Full marks: 100, Sessional: 50, Laboratory: 50, Time; 3hours

SCREW THREAD & SCREWED FASTENER:

Profiles of various threads; Representations of various kinds of threads; Different types of nuts and bolts; Locking devices for nuts.

RIVETTED JOINTS:

Different types of Laps and Butt joints; Rivetted joints of plates at right angles.

KEYS, JOINTS & COUPLINGS:

Different types of keys; cutter joints; knuckle joints; muff coupling; flange coupling; universal couplings.

PULLEYS:

Stop pulley and V-belt pulley.

PIPE JOINTS:
Flanged joint; Hydraulic joints.
GEARINGS:
Construction and representation of involute teeth profile and nomenclature.
ASSEMBLY DRAWING:
Engine parts: 1) Piston, 2) stuffing box, 3) Cross-head 4) Connecting and connecting ends 5) Eccentric.
Valves:
1) Stop valve, 2) Feed check valves 3) Blow off cock 4) Non-return valve.
Bearings: 1) Thrust bearing 2) Pedestral bearing
Computer aided drafting, Introduction to autocad – solid modeling, Computer graphics.
Detailed workshop drawing:
Pipe vice, Chuck, Tail stock of lather screw jack; different symbols in workshop drawing.
Books:
1. Machine drawing – N D Bhatt.

ME: 324 Workshop Theory – I (3-1-3) (for ME only)
Theory: 100, Sessional: 50, Laboratory: 50, Time: 3hrs.

Unit- I

Single point cutting tools – Reference planes – System of axes. Tool specifications – ASA, ORS, MRS and NRS systems. Conversion of tool angles, Selection of tool angles. Tool materials and fabrication, Cutting Fluids.

Unit –II

Lathe- Functions, Classification and Specification- Different parts- Drive mechanisms speed and feed- Taper turning- Gear cutting- Machining time calculation. Lathe Accessories and Attachments.

Unit-III

Shaper – Functions, Classification and Specification – Different part of a shaper – Quick return and feed mechanisms – Shaper operations – Cutting speed and Machining time calculations.

Unit-IV

Planer - Functions, Classification and Specification – Difference between shaper and planer – Table drives and feed mechanism – Planer operations – Machining time.

Unit-V

Drilling machines – Classification – specifications – Parts of an Upright drilling machine – spindle drive mechanisms – tool and work holding devices. Types of drills and twist drill nomenclature, Drill size and designation of drills. Deep hole drilling operation. Machining time. Introduction to reaming – reaming tools – reaming allowances. Introduction to tapping – Tap drill size.

Unit-VI

Pattern making and sand casting – Pattern materials – Types – Pattern allowances. Coreprints. Moulding sand – ingredients – classification – sand additives – properties of

moulding sand – sand preparation and testing. Green sand mould preparation. Cores and core making – Types of cores.

Unit-VII

Welding and related processes – Types of welding. Gas welding – Gas flame – welding techniques – welding equipment. Arc welding – Principle – equipments – Polarity – Electrodes- Arc welding methods – MIG, TIG, Atomic Hydrogen Arc and Plasma Arc welding. Resistance welding – Principle – Methods. Oxygen and Arc Cutting. Welding methods of – Carbon steel, Stainless steel, Cast iron, Aluminium and Copper. Inspection and testing of welds. Soldering and Brazing.

Books:

1. Elements of Workshop Technology (Vol. I & II) – S.K. Hajra Coudhury and A.K. Hajra Coudhury.
2. A course in Workshop Technology (Vol. I & II) – B.S. Raghuwanshi
3. Manufacturing Technology – P.N. Rao – Tata McGraw Hill
4. Workshop Technology-I – P.K. Sapra and R.K. Kapur- Vikas Publishing
5. Elements of Manufacturing Processes – B.S. Nagendra Parashar and R.K. Mittal – PHI.
6. Introduction to machining Science – G.K. Lal, New Age International Limited

ME 317: BASIC MECHANICAL ENGINEERING (2-0-3*) (for CE)

Theory: 50 Sessional: 50 Time: 3hours

Unit 1 :(only a treatment in outline is required for each topic and coverage in depth is required-no mathematical problems)

Energy- Definition, types, sources- traditional and non-traditional, application, merits and demerits of each type of non-conventional energy.

Utilization of conventional energy-power plants:-

Steam power plants, layout, components with block diagram

Diagrammatic description of boiler and its mountings and accessories.

Diagrammatic description of turbine, condenser with working principles.

I.C.Engines: principle and working of Petrol and Diesel engine and comparison .

Principles of Gas turbines and Nuclear Plants.

Principle and working of Refrigerators and Air-Conditioner.

Laws of Thermodynamics.

Lift mechanism.

Unit 2(Brief descriptions, principles, relevant formula without deduction, simple mathematical problems)

Mechanical power transmission systems:-

Gear-types, velocity ratio, simple problems.

Belt and rope drive-types, equation for torque, HP transmitted, width of belts, simple problems.

Essential components:-

Governor and Flywheel-description, simple problems.

Mechanical unbalance.

Mechanical aspects of pump.

Unit 3 (Principles with diagram only)

Production processes

Casting-moulding, melting, advantages and disadvantages, defects.
Forging- types, principles.
Welding-types, advantages and disadvantages, applications.
Reference Books
Unit 1 and 2:- Basic Mechanical Engineering –T.S.Rajan-Willey Eastern
Unit3:-Teory of Machines-Dr.J.Lal-Metropolitan Books Ltd.-New-Delhi
Laboratories:-Demontration of
(a)Boiler-mountings and accessories.
(b)I.C.Engines, Steam Engines
(c) Refrigerators and Air-Conditioner
(d)Governor, gear, belt and rope drive, flywheel.
(e) Pump
(f) Covered in W.P-I,II

ME 425 MECHANICS OF MATERIALS (3-1-3) (for ME)

Theory – 100 marks Sessional – 50 marks Lab – 50 Time – 3 hrs.

1. Complex stresses and strains:
a) Two-dimensional stress systemss : Stresses on oblique planes due to two direct and shear stresses. Principal stresses, Mohr's cycle for stresses. Strain on oblique planes, Mohr's cycle for strain. Strain Rosette.
b) Three-dimensional stress system: Principal stresses, direct and shear stresses on octahedral planes. Mohr's cycle for tri-axial stress systems. Simple cases.
2. Stresses due to combined bending and torsion of circular shaft.
3. Thick cylinder: Lame's equation, Longitudinal and shear stress, stresses due to shrunk fit.
4. Stresses in discs of rotation.
5. Stresses in curved beams: Stresses in crane hooks, rings.
6. Stresses in circular helical spring.
7. Deflection of beams: Integration method,Energy methods, Theorem of Castigliano. Maxwell Bette reciprocal theorem.

Books:
1. Elements of strength of materials by Timoshenko
2. Strength of materials by D S Bedi
3. Mechanics of materials by J P Denhartog.

ME 426: FLUID MECHANICS – I (3-1-3) (for ME)

Theory 100 marks Sessional 50marks Laboratory 50marks Time 3 hours

Unit I : Introductions Significance of flow properties, Classification of fluids based on variation of viscosity, Continuum, No slip condition of viscous liquids.
Unit II : Fluid Statics Fundamental equation in vectorial form, pressure at a point, constant density and temperature solution, unit and scales of pressure measurement, pressure measuring devices, Hydrostatic force on a horizontal plane, Vertical plane, inclined and rough surface, Buoyancy stability of floating and submerged bodies, Metacentre and Metacentric height.

Unit III : Kinematics of Fluids Flow field and description of fluid motion, Material derivative and acceleration, streamline, path line, streakline, stream tube, steady and unsteady flow, uniform and non uniform flow, Rotational and Irrotational flows, Translation, Vorticity, Stream function, Velocity potential function, Flow net.

Unit IV : Elementary Flows in a two dimensional plane Introduction, Uniform flow, Source and Sink, Vortex Flow, Free and Forced Vortex, Doublet, Continuity equation and its analysis based on integral form.

Unit V : Dynamics of Fluid Flow Euler's equation of motion and its Vectorial approach. Euler's equation along a streamline, analytical and Vectorial approach of Bernoull's equation, General Energy equation and momentum equation and vectorial approach, application of Bernoulli's equation to real fluid flow, Dynamic forces on plain and curved surfaces due to impingement of liquid jets.

Unit VI : Flow Measurement Concept of static and stagnation pressures, application of Pitot tube in Flow Measurements, Pitot Static tube, Hot wire anemometer, venturimeter, Loss of head in a venturimeter, Orificemeter and its classification, the phenomenon of jet contractions, Hydraulic co-efficient of an Orifice, Factors affecting the Orifice co-efficients.

Unit VII : Dimensional Analysis and its applications Introduction, Dimensionless numbers and its significance, Fluid flow problems, drag in immersed bodies.

Unit VIII : Fluid Frictions Critical Reynold's numbers, relation of Shear stress and pressure gradient, Steady laminar flow through circular pipes, flow between parallel plates, Couette flow,
Occurrence of back flow.

Reference Books :

1. Fluid Mechanics ------ Dr. A. K. Jain.
2. Fluid Mechanics ------ Dr. J. Lal
3. Fluid Mechanics and machines ----- V. L. Streeter.

ME 427: Materials Science (3-0-2) (for ME)

Theory: 100 Sessional: 50 Time: 3hrs.

Unit-I

Introduction to Materials Science and Engineering- Classification of engineering materials. Brief review of Crystal Structures- Crystal Directions and Planes. The Bragg Law of X-ray diffraction, Powder method and structure determination.

Unit-II

Bonding in solids- Specifically Metallic Bonding. Solid solutions and Intermetallic Compounds. Solidification of metals and alloys- Nucleation and grain growth-Nucleation kinetics- Recovery, recrystallisation and grain growth.

Phase diagrams- Gibbs phase rule- Binary phase diagrams- Eutectic and eutectoid peritectic and peritectoid systems. Fe-C equilibrium diagram- TTT diagram

Unit –III

Principles of heat treatment and general heat treatment processes. Case hardening, surface hardening, precipitation hardening and maraging. Heat treatment of steels.

Unit-IV

Mechanical properties of materials and testing- Tensile, compressive, impact, hardness, fatigue and creep testing. Non-destructive testing.

Work hardening, Bauchinger's effect, preferred orientation, elastic after affect and season's cracking.

Unit-V

Lattice defects, Deformation by slip, Slip by dislocation movement, Critical resolved shear stress for slip, Deformation of single crystals, Deformation by twinning, Stacking faults, deformation of polycrystalline materials.

Unit-VI

Diffusion, oxidation and Corrosion.

Diffusion types- Mechanisms and Laws of diffusion- Variables affecting diffusion.

Oxides types- Mechanism of film growth and rate of growth- protective oxides- Selective oxidations- Benefits and adverse effects- Control of oxidation.

Factors influencing corrosion- Mechanisms, Types, Electrochemical and Galvanic corrosion, Passivation and Polarisation, Liquid metal corrosion, Rusting of Iron.

Unit- VII

Electronic properties of materials- Conductors, semiconductors and insulators.

Magnetism and magnetization- diamagnetism, paramagnetism and ferromagnetism. Dielectric materials.

Unit- VIII

General introduction to engineering alloys- Tool and Die steels, Heat and Scale resistant steels, Babbitt materials, Cu-based, Al-based and Ni-based alloys. Composites.

Books:

1. Materials Science and Engineering – V. Raghavan, PHI
2. Materials Science – Van Black, Prentice Hall International
3. Materials Science – A.K. Gupta and R.C Gupta
4. Physical Metallurgy Principle – V. Raghavan, PHI
5. Mechanical Metallurgy – George E. Dieter, McGraw Hill Book Company

ME 522: MECHANISMS AND DYNAMICS OF MACHINES(3-1-2)

Theory: 100 Sessional: 50 Laboratory: 50 Time: 3Hours

Chapter – I: Kinematic analysis of plane motion:

Velocity diagram, Acceleration diagram, Coriolis component of acceleration, Analytical method of kinematic analysis.

Chapter – II: Kinematic synthesis of linkages:

Introduction, number synthesis, basic features, analytical methods, graphical methods.

Chapter – III: Mechanisms:

Mechanism, Mobility, Inversion, Test for 4 bar mechanism by Grashoff's law, Straight line mechanism, Oscillatory mechanism, Quick return mechanism, Steering mechanism, Spatial mechanism – Hook's joints.

Chapter IV: Gyroscopic action in machines:

Gyroscopic action and force, method of analysis, Gyroscopic action in certain machine elements, use of gyroscopic principles in instruments.

Chapter V: Balancing of rotating masses, Two plane balancing, Balancing of reciprocating masses, Graphical solution, Balancing of single cylinder and multi-cylinder engines, Firing order, Balancing of rotors, Field balancing, Balancing instruments.

Books:

1. Theory of machines by T. Bevon
2. Theory of mechanism and machines by Ghosh & Mallick, Tata McGrow Hills
3. Theory of Machines by J. Lal , Metropolitan Books Ltd.
4. Theory of Machines and Mechanisms (3rd edition) by J.J.Uicker,Jr;G.R.Pennock & J.E.Shigley, Oxford University Press.
5. Theory of Machines by V.P.Singh,
6. Theory of Machines by A. Shariff

ME523: APPLIED THERMODYNAMICS – I(3-1-3)

Theory: 100 Sessional: 50 Lab:50 Time: 3Hours

1. **Availability:** Available and unavailable energy, Available energy referred to a cycle, Availability in non-flow or closed system (Non-cyclic), Availability of steady-flow systems, Helmohltz and Gibb's functions, Irreversibility and loss in availability, Effectiveness.
2. **Boiler:** Classification of boilers, mountings, accessories, evaporation capacity, equivalent evaporation, boiler efficiency, selection of a boiler, boiler feed water treatment and boiler troubles.
3. **Basic steam power cycles:** Carnot and Rankine cycles, Modified Rankine cycle, Regenerative and Reheat cycles.
4. **Steam nozzles:** Expansion of steam through nozzles, velocity and pressure variation in nozzles, Critical pressure ratio, mass flow rate and maximum mass flow rate, Representation of heat drop in nozzles in Mollier diagram, Nozzle efficiency.
5. **Steam turbines:** Classification, Flow of steam through impulse and reaction turbines, Velocity diagrams, Reheating, Bleeding, Reheat factor, Compounding and governing of steam turbines, Back pressure turbines, Pass out turbines.
6. **Steam condensers:** Function of steam condenser, Elements of a condenser plant, vacuum production, Delton's law of partial pressure, Classification of condensers, Sources of air leakage in condensers and their effects, Removal of air from the condesers, Vacuum efficiency and condenser efficiency, Determination of cooling water, Cooling towers and cooling ponds.

   Books:

   1. A course in thermodynamics and heat engines by Domkundwar, Kothendaraman, Khajuria and Arora, Dhanpat Rai and Sons.
   2. Thermal Engineering by Rajput, Laxmi Publications.
   3. Elements of heat engines by Patel, Karamchandani
   4. A text book of thermal engineering by Khurmi, Gupta, K Chand Publications.

ME524: HEAT TRANSFER – I(3-1-3)

Theory: 100 Sessional: 50 Laboratory: 50 Time: 3hours

1. INTRODUCTION Concept of modes of Heat Transfer

2. CONDUCTION HEAT TRANSFER General 3-D differential equation for heat conduction, Boundary conditions and their types.
3. ONE DIMENTIONAL STEADY STATE HEAT CONDUCTION System with or without heat generation: slab, cylinder, sphere, Concept of thermal resistance and electrical analogy, Variable thermal resistance and electrical analogy, Composite systems: slab, co-axial cylinder, concentric sphere, Critical radius of insulation, Fins
4. ONE DIMENTIONAL UNSTEADY STATE HEAT CONDUCTION Lumped system analysis , Response time of a temperature measuring instrument, Mixed boundary condition
5. RADIATION HEAT TRANSFER Nature of thermal radiation, emissive power, Absorption, Reflection and Transmission, Concept of a black body, Intensity of radiation, Laws of black body radiation, Radiation to and from real surfaces
6. RADATIVE HEAT EXCHANGE BETWEEN SURFACES Radiation between two black bodies, Radiation shape factor (View factor) and its properties. Shape factors for different geometries, Radiation between two infinite parallel places, Radiation between two infinitely long concentric cylinders, Radiation between grey bodies, Electric network analogy for thermal radiation, Radiation shields, Radiation combined with convection
7. DIFFUSION MASS TRANSFER: Concentrations, Velocities and Fluxes, Fick's law of diffusion, the diffusion co-efficient, Species conservation equation and the boundary equation, Steady state molecular diffusion

Books:

1. Heat transfer, a basic approach by M N Ožišik , McGow Hills.
2. Heat and Mass Transfer by R C Sachdeva, Wiley Eastern.
3. Heat transfer, by P.S. Ghoshdastidar, Oxford University Press

ME525: INSTRUMENTATION (3-1-3)

Theory: 100 Sessional: 50 Laboratory: 50 Time: 3hours

1. Definition of Instrumentation.
2. Dynamic characteristics of instruments and instrumentation system, Linear and non-linear systems, Electrical networks, Mechanical systems, Analogous systems, Thermal systems, First and Second order systems.
3. Measurement of linear displacement and linear displacement transducer (i) Resistance potentiometer, (ii) Strain gauge, (iii)Variable inductance transducers, (iv) Linear variable differential transducers(LVDT), (v) Capacitive transducers, (vi) Piezo electric transducers.
4. Measurement of rotary displacement and rotary displacement transducers (i) Resistance potentiometer, (ii) Strain gauge, (iii) Rotary variable differential transducers, (iv) Capacitive transducers, (v) Shaft encoder.
5. Strain gauges: Measurement of strain and applications of strain gauges.
6. Measurement of pressure with secondary transducers (i) Resistive , (ii) Inductive , (iii) Capacitive, (iv) Piezo-electric transducers.
7. Measurement of torque (i) Strain gauges, (ii) Torque meters, (iii) Inductive torque transducers, (iv) Digital method, (v) Magneto-stricture transducers.
8. Measurement of linear velocity (i) Moving magnet type transducer , (ii) Moving coil type transducer, (iii) Seismic type velocity transducers.
9. Measurement of angular velocity: (i) AC and DC tachometer generators, (ii) Drag cup rotor AC, (iii) Photo-electric tachometer, (iv) Stroboscopic methods.

10. Measurement of vibrations: (i) Seismic transducers, (ii) LVDT accelerometers, (iii) Piezo-electric accelerometers.
11. Measurement of temperature: (i) Platinum resistance thermometers, (ii) Thermocouples, (iii) Thermistors, (iv) Optical pyrenometers.
12. Measurement of flow: (i) Turbine meter, (ii) Electro-hydro-dynamic flow meters, (iii) Hot wire anemometer.
13. Measurement of sound using microphone.
14. Measurement of thermal conductivity; (i) Gas analyzer (ii) Using thermistors.
15. Cathode ray oscilloscope: observation of wave forms, measurement of voltage and current, Lissajous patterns for measurements of phase and frequency.
16. Signal conditioning; (i) AC amplifiers, (ii) operational amplifiers and specifications, (iii) Charge amplifiers, (iv) Amplitude modulations and demodulations , (v) Different types of filters, (vi) Wheatstone bridge, (vii) Inductive transducers and AC bridges, (viii) Blumlein bridges, (ix) Integration and differentiations (x) Analog- Digital and Digital- Analog conversion techniques.
17. Introduction to display devices.
18. Recorders : (i) Analog recorders, (ii) Strip chart recorders, (iii) Galvanometers type recorders, (iv) Null-type recorders, (v) X-Y recorders, (vi) Ultra-violet recorders, (vii) Magnetic tape recorders, (viii) Frequency method recorders, (ix) Pulse duration modulation recorders, (x) Direct recording, (xi) Digital tape recording .
19. Control systems and components: (i) Linear approximation and non-linear system, (ii) Servo-motors, (iii) AC tachometer, (iv) Amplidyne, (v) AC position control system, (vi) Stepper motors.

References:

1. A course in Electrical, Electronics measurements and Instrumentation-A.K.Shawney.
2. Automatic control systems-Benjamin and Rao.
3. Control system Engineering- I.J.Nagrath and M.Gopal.

ME 526: MACHINE DESIGN I (3-0-3) (For ME & IPE)

Theory -100 marks Sessional-50 marks Time 4hours

Unit I: Introduction General considerations and procedure for designing, types of Loads, Designed stress and factor of safety, stress concentration, selection of materials, codes for design-BIS codes, Failure theories, Fits and Tolerance.

Unit II:Joints a) Detachable joints: Design of threaded fasteners, thread forms and threaded fastener types and materials, bold tightening and initial tension, Power screws.

b) Permanent Joints: Riveted joints and welded joints – eccentric loading.

Unit III:Shafting Design of shaft subjected to bending, torsion, axial and combined loading, keys, cotter and Knuckle joint.

Unit IV: Coupling Rigid and Flexible coupling.

Unit V:Power Transmission Element Belt and Chain Drives, design of Flat and V-belts.

Unit VI:Bearing Journal Bearing, Mechanism of fluid film lubrication, fluid viscosity, Petroff's Equation.

Books:

1. Machine Design by Black and Adams (TMH)
2. Design of machine elements by M F Spott
3. Design of machine elements by B V Vandari (TMH)
4. Machine Design by Hall
5. Machine Design by Khurmi and Gupta
6. Machine Design by Bahl and Goel

7. Machine Design by Shigley.

ME 621: MACHINE DESIGN II (3-0-3) (for ME & IPE)

Theory 100 marks Sessional50marks Laboratory 50marks Time 4 hours

Unit I : Design against static load Different type of load and stress, Mode of failure. Factor of Safety.

Unit II : Design against fluctuating load Stress concentration, fluctuating stresses, Fatigue failure, endurance limit, Notch sensitivity, cumulative damage in fatigue, Soderberg and Goodman Diagrams, Fatigue design under combined stresses.

Unit III : Design Considerations and simple cases of design for

a) Mechanical Spring – helical spring
b) Friction clutches – single and multidisc clutch, cone clutch
c) Brakes – Disc, cone, band, and internal expanding shoes
d) Spur Gear, Helical gear
e) Bearing – radial and Thrust journal bearings, antifriction bearings
f) Cams
g) Gasket for static load, in vessel opening

Reference Books:

1. Machine Design (Tata McGraw Hills) ----- Blach and Adams
2. Design of Machine elements (-do-) ----- B. V. Bhandari
3 Machine Design (….) ------- Bahl & Goel
4. Machine Design ----- Hall
5. Machine design ----- Shigley
6. Design of Machine elements ----- M. F. Spot.

ME 622: Operations Research (4-0-0) (for ME &IPE)

Theory100 Sessional 50 Time: 3hours

1. Introduction to OR, Engineering applications, Statement of an OR problem, Type of problems handled in OR.
2. (a) Linear programming (deterministic) – Problem formulation, Feasibility and Optimality, Basic and Non-Basic solutions
   (b) Graphical method of solving LPP, Simplex Algorithm and problem solutions, Use of Slack, Surplus and Artificial variables and their meanings
   (c) Big-M method and 2-phase method
   (d) Dual Simplex algorithm
   (e) Meaning and examples of Unique, Alternate/Multiple, Unbounded and Infeasible solutions.
   (f) Degeneracy and Cycling
3. Special Linear Programming problems – their formulations and solutions in such cases as Integer Programming Problem (IPP), Transportation Problem (TP) and Assignment Problem (AP). Discussion on method extended to Travelling Salesman Problem (TSP).
4. Classical Optimisation – Introduction, Single and Multi-variate problems, Lagrangean method, Karush-Kuhn-Tucker (KKT) conditions
5. Inventory modelling – Classification of inventory, Deterministic versus Stochastic problem situations, Formulation and Solution of Deterministic inventory problems,
6. Simulation – Meaning, Monte-Carlo simulation, generation of random observations, Use of digital computers in simulation, Discussion on simulation examples such as inventory, queuing etc.

Text and references

1. Operations Research – H A Taha
2. Operations Research – Gupta and Hira
3. Operations Research – Billy E Gillet
4. Operations Research – Panneerselvam
5. Optimisation – S S Rao
6. Operations Research – N G Nair
7. System Simulation by digital computers – N Deo

ME 623: FLUID MECHANICS – II (3-1-3)

Theory100 marks Sessional50marks Laboratory 50marks Time3 hours

Unit I : Compressible Flow: Perfect gas, Propagation of elastic waves, wave pattern under varying Mach number, Prandtl Mayer relation, Maximum mass flow and chocked condition, Isentropic flow, Shock waves-Normal shock, Impossibility of shock in subsonic flow, Moving normal shock waves, Effect of Mach numbers on compressibility, Fanno flow, Rayleigh flow, Isothermal flow in long pipelines, Oblique shock and nature of flow, Compression corner and expansion corner, Supersonic flow over a wedge.

Unit II : Viscous Flow: Characteristics of laminar and turbulent flow, Boundary layer equation, Blasius flow over flat plate, Wall shear and boundary layer thickness, Momentum integral equation for boundary layer, Separation of boundary layer, Entry flow in a duct, Control of boundary layer separation, Mechanics of boundary layer transition, Several events of transition, Form drag and skin friction drag.

Unit III : Turbulent Flow Characteristics, Classification, Theories of Turbulent, Mean Motion and Fluctuations, derivation of Governing equation for turbulent flow, boundary conditions, Prandtl's mixing length, universal velocity distribution Law and Friction factor in Duct flow for very large Reynold Numbers, Karman's similarity hypothesis, velocity distribution, shear velocity, hydraulically smooth and rough boundaries, velocity distribution in rough pipes, Nikuradse's Experiment on artificially roughened pipes, Karman-Prandtl resistance equation.

Reference Books :

1. Fluid Mechanics (Tata McGraw Hill) -------- V. L. Steeter
2. Fluid Mechanics (Prentice Hall India) ------- A. Mohanti
3. Fluid Mechanics (ELBS) ------- Massey
4. Gas Dynamics (PHI) ------ E. Rathakrishnan

ME 624: ENGINEERING INSPECTION AND METROLOGY (3-1-2),(for ME &IPE)

Theory: 100 Sessional: 50 Laboratory: 50 Time: 3hours

1. **Introductory concept**: Meaning of engineering inspection and Meaning of engineering metrology. Controlling quality through inspection, types of inspection, merit/demerit of 100% inspection, Sampling inspection – Representative sample. Different methods and techniques of measurement. Standards of measurement and sub-division of standards.
2. **Statistical Process Control**: Product variations – Chance causes and assignable causes, Control charts and its significance in statistical process control, Computer implementation of control charts.
3. **Limits of size and fits**: Concept of tolerance, allowance and clearance. Natural tolerance limits, process capability and Specification limits. Hole and shaft basis systems of specifying limits of size and tolerances. Indian Standard for fits and tolerances.

Limit gauges – hole and plug gauge, Taylor's principle of gauging. Tolerances and allowances during design of gauges.

Interchangeability – its importance in production, techniques of achieving interchangeability during manufacturing.

4. **Measurement of screw threads**: Terminologies of screw threads. Measurement of various parameters of screw thread such as diameter, thread angle, effective diameter and pitch. Use of screw gauge and pitch gauge, Use of diameter and pitch measuring machines. Two and three wire methods.

   Use of Profile projectors and Tool Maker's Microscope (TMM) in the measurement of thread elements
5. **Measurement of gears**: Gear tooth profiles – involute and cycloidal, involute function. Spur gear measurements for run-out, pitch, profile, backlash. Parkinson gear tester. Measurement of tooth thickness – chordal thickness method, constant chord method, base tangent method. Check for pitch circle diameter and tooth spacing.
6. **Surface texture**: Meaning of surface texture, order of geometrical irregularities, elements of surface texture. Meaning of roughness and fineness. Roughness width cut-off. Representation of surface roughness. Estimation of surface roughness. Measurement of surface roughness by stylus equipment.
7. **Interferometry**: – Principle of interference. Use of optical flat. Gauge interferometer – Principle NPL gauge interferometer. Laser interferometer.
8. **Alignment testing:** – Optical methods for alignment testing, Laser alignment testing.

Texts and references:

1. Engineering Metrology – K J Hume
2. Engineering. Metrology – K W B Sharp
3. Engineering Metrology – R K Jain
4. Engineering metrology – M Mahajan
5. Dimensional metrology – M K Khare and S Vajpayee.

ME 625: Workshop Theory- II (3-0-3)

Theory: 100 Sessional: 50 Lab:50 Time: 3hrs.

Unit-I –Mechanics of metal cutting:

Mechanism of chip formation – Type of chips. Orthogonal and oblique machining, Chip thickness ratio and velocity relationship, Stress, Strain and Strain rate, Merchant Theory of metal cutting, Measurement of cutting forces, Cutting variables and factors affecting them. Tool wears and Tool life – Basic causes – Progressive tool wears – Tool life – Variables affecting tool life – Specifications and criteria for tool life. Machinability – Factors – Criterion.

Unit-II – Semi-Automatics:

Capstan and Turret lathes – Different parts – Tools —Work and Tool holding devices. Indexing and Bar Feeding Mechanisms. Tool layout and Tool Schedule chart.

Unit-III – Milling:

Introduction – Classification – Principal parts of a column and knee type milling machine – Specifications. Spindle drive and feed mechanism, Elements of a milling cutter, Milling processes – Up-milling – Down milling – Face milling – End milling. Cutting Speed,

Feed and Depth of Cut – Machining Time. Indexing and Dividing Head – Indexing Methods. Spur and Helical gear milling Operations – Selection of Cutter for gear cutting.

Unit-IV – Grinding:

Introduction – Kinds of grinding – Grinding Processes – Centreless Grinders – Surface Grinders – Tool and Cutter Grinder – Specifications. Grinding Wheel – Abrasives – Bonding processes – Grit, Grade and Structure – Marking system of grinding wheel – Selection of Grinding Wheel. Mounting, Dressing, Truing and Balancing of grinding Wheel.

Unit-V – Jigs and Fixtures:

Introduction – Elements of Jigs and Fixtures – Principle of Location – Locating Methods and Devices – Design Principle for Location. Clamping – Principles for Clamping – Clamping Devices. Indexing Jigs and Fixtures – Indexing devices. Fool- Proofing.

Unit-VI – Non-conventional Machining:

Need for Non-conventional Machining. Principles of operation, Machine setups, Applications, Merits and Demerits of – (a) Abrasive Jet Machining, (b) Ultrasonic Machining, (c) Electrochemical Machining, (d) Electro-discharge Machining, (e) Laser Beam Machining, (f) Electron Beam Machining. Comparative study of the above processes.

Books:

1. Elements of Workshop Technology (Vol. I & II) – S.K. Hajra Coudhury and A.K. Hajra Coudhury.
2. A course in Workshop Technology (Vol. I & II) – B.S. Raghuwanshi
3. Manufacturing Technology – P.N. Rao – Tata McGraw Hill
4. Introduction to Machining Science – G.K. Lal, New Age International Limited
5. Jigs and Fixtures – P.H. Joshi, Tata McGraw Hill
6. Manufacturing Science – Amitabha Ghosh and Asok Kumar Mallick, East West Press
7. Non-Conventional Machining – P.K. Mishra, Narosa Publishing House.

ME 626: NUMERICAL METHODS AND COMPUTATION(3-1-2)

Theory: 100 Sessional: 50 Time: 3hrs

1. Solution of Algebraic and Transcendental Equations: Newton-Raphson, Successive Approximation, Comparison of Iterative methods
2. Solution of Linear Simultaneous Equations :
   Gauss Elimination Method, Gauss-Seidal Methods,
3. Basics of Finite Difference Methods :
   Finite differences, Difference representation of ODE & PDE, Error analysis, Convergency
4. Application of Finite Difference Methods
   (i) Heat conduction equation (one and two dimensional)
   (ii) Laplace's Equation

Books:

1. Numerical methods with Computer Programs in C++
   By Pallab Ghosh, Publisher: Prentice Hall of India Pvt. Ltd.
2. Computational Fluid Mechanics and Heat Transfer
   By Anderson, Tannehill & Pletcher. Publisher: Hemishphere Publishing Corporation

ME 721 MECHANICAL VIBRATION(3-1-1)

Theory 100 Sessional 75 Time 3 Hrs

Chapter: 1 BASIC CONCEPTS (4 classes)
Introduction, importance, main causes of vibration, characteristics of vibration Harmonic Analysis, Beats, Periodic and non-harmonic excitation, mathematical models, Elements of a Vibratory System, lumped or Discrete parameter system, Continuous or Distributed parameter systems, Equivalent springs and dashpots.
Chapter: II UNDAMPED FREE VIBRATION; 5 classes, 2 tutorials
Introduction, Derivation of differential equation motion-energy method, Newton's 2nd law method, Rayleigh's method. Solution of differential equations of motion, Angular Oscillation- compound pendulum.
Chapter: III DAMPED FREE VIBRATION; 5 classes, 2 tutorials
Introduction, Viscous damping, free vibration with viscous damping – overdamped, critically damped and under damped system, critically damping co-efficient , Logarithmic Decrement, Coulomb damping, Structural damping, interface damping-comparisons
Chapter:IV FORCED VIBRATION (SINGLE DEGREE FREEDOM SYSTEM); 6 classes, 2 tutorials
Introduction , Forced harmonic vibration , magnification factor , resonance, Excitation due to unbalance – rotating reciprocating, vibration isolation force transmissibility , motion transmissibility.
Chapter:V SESMEIC INSTRUMENTS : 3 Classes, 1 tutorials
Introduction, vibrometer, accelerometer, phase distortion.
Chapter :VI SYSTEMS WITH TWO DEGREES OF FREEDOM -6 classes 2 tutorials
Introduction, Principal modes of vibration, modes shapes, Torsional Vibration, coordinate coupling- static and dynamic, Dynamic Vibration Absorber, Torsional Vibration Absorber, Pendulum type vibration Absorber, Generalized Co-ordinates
Chapter :VII MULTI DEGREE FREEDOM SYSTEMS -6 classes 2 tutorials
Introduction, equation of motion, matrix methods, orthogonality and principal mode of vibration, Approximate method of determining fundamental frequencies- Dunkerley's method, Rayleigh's method, Holzer's methods, method of matrix iteration.
Chapter :VIII WHIRLING MOTION AND CRITICAL SPEED 2 classes, 1 tutorial
Introduction, critical speed of a single rotors, multiple rotors.
Chapter : IX NOISE ENGINEERING 3 classes, 1 tutorials
Introduction, Subjective response to sound, sound spectra, types of sound fields, loudness of composite sound, Equivalent sound level, auditory effects of noise. Noise standards and limits, Major source-industries, Survey and measurement technique Industries noise control strategies.

Text Books

1. A.G. Ambekar, Mechanical Vibration & Noise Engineering. Prentice–Hall of India Pvt. Ltd.
2. Thomson W.T. Vibration Theory & Application, 2nd Ed. Prentice–Hall
3. Tse Morse Hankle- Mechanical Vibration Theory and Application. Prentice–Hall of India Pvt. Ltd, New Delhi
4. Church A H Mechanical Vibration John Wiley & Sons, Newyork

ME722: APPLIED THERMODYNAMICS – II(3-1-0)

Theory100 Sessional75 Time3Hours

Chapter 1 : Air Compressors Introduction; Reciprocating type – Single stage and multi-stage, Compression ratio and volumetric efficiency, effect of clearance, compressor

efficiencies. Methods for improving thermal efficiencies. Compressor work and power. Intercooler and after-cooler. Rotary compressors – Classification, Centrifugal compressors – theory of operations, impeller and diffuser, impeller work; efficiency. Rotary Vs Reciprocating compressor. Introduction to axial flow compressors, charging and choking of compressors.

Chapter 2: Gas Turbine Introduction – gas turbine cycles – open and closed, Ideal and Actual cycles. Isentropic efficiencies and thermal efficiencies. Power output. Methods to improve thermal eficiencies; Gas turbine Vs I C Engines.

Chapter 3: Jet and Rocket propulsion Introduction. Types of jet engines – turbojet, turboprop, ramjet, pulsejet. Analysis of turbojet engine cycle, thrust, jet thrust, propeller thrust, effective speed ratio, specific fuel consumption, thrust, impulse, performance. Types of rocket engines – solid propellants rockets, liquid propellants rockets, hybrid rockets, analysis of rocket propulsion, performance, comparison between jet and rocket propulsion.

Chapter 4: Refrigeration Inroduction – Reversed Carnot cycle and air refrigeration cycles; COP; Capacity of a refrigerating unit. Vapour compression and vapour absorption cycles. Properties of refrigerants. Heat pump.

Chapter 5: Psychrometry Introduction; Psychrometric terms; Delton's law of partial pressures. Psychrometric processes. Psychrometric chart. Psychrometr.

Reference books:

1. Applied thermodynamics --- T. D. Eastor and A McConkey, ELBS (Longman)
2. Thermal Engineering --- P. L. Ballaney.

ME 723: HYDRAULIC MACHINES(3-1-0)

Theory-100 marks Sessional -75marks Time3 hours

Review of Euler equations of Turbo –machinery: Radial, axial and mixed flow machines. Impulse and Reaction machines. Specific speed, specific diameter, efficiency.

Turbines Pelton wheel, wheel diameter, jet diameter, bucket shape, size and number, speed control of Pelton wheel.Use of Pelton wheel and efficiency, specific speed and specific diameter range.

Francis –runner, flow and speed ratio, casing guide, vanes, flow control, speed control, runner shape variation with the change of specific speed. Draft tube, surge tank, penstock, cavitation.

Axial flow turbine and Kaplan turbine. Blade profile, specific speed, diameter change of blade, pitch, guide vane, flow control, cavitation characteristics, draft tube, speed control of Kaplan turbines.

Centrifugal pumps-single and multistage, radial and mixed flow pumps, vane pump, volute casing pump. Pump efficiencies-hydraulic efficiency, overall efficiency, loss in pump, speed ratio, efficiency. Pump characteristics- surging, cavitaion on pump. Priming of centrifugal pumps, self priming of pumps, multi stage pumps, runner, casing and stationary vanes.

Axial pump-specific speed, flow ratio, speed ratio characteristics, applications. Propeller pump, blade-shape and aerofoil analysis-lift and drag estimate of pressure rise and power requirements.

Fluid couplings, Hydraulic dynamometer, reciprocating pumps, Gear pumps

ME724: HEAT TRANSFER - II(3-1-1)

Theory: 100 Sessional: 75 Time: 3hours

A. Fundamentals of Convective Heat Transfer:

Introduction; The basic equations, the convective heat transfer co-efficient;

B. Forced convective systems:

Forced convection over a flat-plate (External flow), Heat transfer and temperature distribution for flow between parallel plates, Forced convection in circular tubes (Internal flow).

C. Free Convection:

Laminar boundary layer equations of free convection on a vertical flat-plate, concept of Grashoff number, Empirical correlations for vertical plates, horizontal plates, inclined surface, vertical and horizontal cylinders, spheres.

D. Heat exchanger analysis & design

Types; Overall heat transfer co-efficient. Fouling factor, LMTD methods of analysis, Effectiveness – NTU method. Pressure drop and pumping power, Aspects of design, double pipe heat exchanger; Shell and tube heat exchanger; Condensers, Optimization of heat exchangers.

F. Boiling and Condensation:

Boiling heat transfer phenomena, Boiling correlations, Laminar film-wise condensation on a vertical plate.

G. Convective mass transfer:

Convective mass transfer co-efficient; the concentration boundary layer. Analogy between momentum, heat and mass transfer, Convective mass transfer correlation, evaporation of water into air.

H. Dimensional analysis:

Application to free and forced convection; application to convective mass transfer.

Recommended books:

1. A basic approach to heat transfer – by M N Ožišik
2. Fundamentals for heat transfer – by Sachdeva
3. Heat transfer, by P.S. Ghoshdastidar, Oxford University Press

ME725(Elective I): REFRIGERATION (3-1-0)

Theory: 100 Sessional: 75 Time: 3Hours

Refrigeration: Introduction, history, methods of refrigeration, Ice, Evaporation expansion of air, throttling of gas, vapour compression and absorption, steam jet, liquid gas, dry ice, units of refr. Difference between engine, refrigerator and heat pump.

Gas cycle refrigeration: Simple cycles – Carnot and Bell-Coleman; Regenerative & reduced ambient system;Air-craft refrigearting system - simple boot-strap, reduced ambient; Actual cycles, ramming; Advantages and disadvantages of DART.

Vapour Compression Systems: Analysis of simple cycles, representation of TS, pH plans; methods of improving COP; Deviations of actual cycles from theoretical cycles. Compound

compression with liquid flash cooler, flash inter-cooler multiple systems – COP, power required, Ewing diagram.

Vapor Absorber Ref. System: Thermodynamical analysis of systems, Advantages and disadvantages, Components, Practical systems NHe Watt. Water LiBr, Electrolux systems, Calculations based on concentration; Properties of binary mixtures.

Non – Conventional Ref. System: Steam jet ref. Thermoelectric, Vortex tube refr. – merits and demerits and applications.

Refrigerants: Nomenclature, classification, desirable properties. Important refrigerants and their comparisons, selection of refrigerants.

Ref. Equipment: Brief introduction to compressors, condensers, expansion devices, evaporators; Piping , line valves, solenoid valves, oil separators, driers, filters, moisture indicators, purging and controls.

Application of Refrigeration: Production of dry ice, cascading, multi-staging domestic, commercial, industrial and medical, preservator of food-spoilage, methods of preservation, cold storage, preparing of insulating materials using in ref. Systems.

Recommended books:

1.Refrigeration and Air-Conditioning by Ahmedul Ameen, PHI

2. Refrigeration and Air-Conditioning by C.P.Arora, Tata McGraw Hill Publication.
3. Refrigeration and Air-Conditioning by M.Prasad

ME 726(Elective II): Computational Fluid Dynamics and Heat Transfer(3-1-0)

Theory100marks Sessional75marks Time3hours

FLUID DYNAMICS

Unit 1: The Basic Equations of Fluid Dynamics:

General form of a Conservation law: equation of mass conservation, conservation law of momentum, conservation equation of energy.

The dynamic levels of approximation:

The Navier-Stokes(NS) equation: The Reynold's averaged NS equation, The thin layer NS approximation, The parabolaised NS approximation, The boundary layer approximation The distributed loss model, The inviscid flow model, Euler equations, steady inviscid rotational flow, The potential flow model, small disturbance approximation of the potential equation, Linearised potential flow, singularity methods, mathematical nature of flow equations.

Basic discretization techniques:

(a)The finite difference method, (b)The finite volume method and conservative discretization.

Analysis and application of Numerical schemes:

Consistency, stability, convergence, Fourier and Von Neumann stability analysis, modified equation ,application of finite difference methods, to wave, heat. Laplace and Burger's equation.

Integration methods for systems of ODE:

Linear multi step methods, predictor-corrector schemes, ADI methods, The Runge-Kutta schemes.

Numerical solution of Euler Equations:

Mathematical formulation of the system of Euler equations, space-centered schemes, upwind shemes for the Euler's equation-Steger and warming flux vector splitting, Van Leer's flux splitting.

HEAT TRANSFER

Basics of finite difference and finite element methods: Numerical methods for conduction heat transfer, Numerical methods for convection heat transfer, Numerical methods for radiative heat transfer.

Reference Books:

1. Computational Fluid Mechanics and Heat Transfer—Hemisphere-Anderson, Tannehill, Pletcher.
2. Computational Heat Transfer-Hemisphere and Springer-Verlag-Jaluria and Torrance
3. Computational techniques for Fluid Dynamics-Verlag-Fletcher and Springer
4. Numerical Computation of Internal and External flows-John-Wiley-Charlse and Hirch

ME 727L: PRACTICAL TRAINING(0-0-2)

Sessional: 50 marks

Factory training for a period of 6 (six) weeks is compulsory for all the Mechanical Engineering Students and 20 marks are allotted for the Technical report submitted after completion of the training. There will be a seminar cum viva on the report submitted by the student and 30 marks are assigned for this. The report should be submitted to the HOD, by a date announced by the HOD. Students are to obtain a certificate from the Factory Authority regarding their attendance and performance during the training period which is to be submitted along with the report.

ME 728L: PROJECT – I(0-0-8)

Sessional marks: 100 Pass marks: 50

Under this course each student will be assigned a topic related to Mechanical Engineering. The project may be extended to Eight semester depending upon the quantum of works required for the project. The students will work under a faculty member and submit a report on the assigned project in a standard FORMAT prescribed by the department.

ME 821: MANUFACTURING METHODS (3-1-0)

Theory – 100 Sessional – 75 Time: 3Hours

Unit-I – Melting and Casting of metals:

Solidification behaviour of pure metals and alloy materials, Centreline shrinkage, Comparative study of different melting furnaces. Special casting methods – Permanent mould casting – Pressure Die casting – Hot chamber, Cold chamber Air blown methods – Low pressure Die casting, Continuous casting. Non-metallic mould casting – Centrifugal casting, Investment casting. Casting defects, their causes and remedies – Fettling of casting – Inspection.

Unit-II – Mechanical working of metals:

Introduction – Classification – Hot, Cold and Warm working – Variables affecting mechanical working process.

Rolling – Principle – Condition for continuous rolling – Methods for reduction of roll separating force – Types of rolling mills – Roll pass design – Roll Piercing.

Forging – Forgeability – Forgeable materials – Metallurgy of Forging – Classification – Hand forging operations – Forging hammers – Drop forging – Press forging – machine forging – Forging Defects – Die design considerations.

Extrusion – Classification – Principle of operations – Variation of ram pressure with ram travel – Principle of operations of Hydrostatic extrusion, side extrusion, impact and Hooker's extrusion.

Wire, Rod and Tube drawing – Principle and Operation.

Unit-III – High Energy Rate Forming (HERF):

Introduction – Reasons that prompted transition to HERF – Classification – Principles and operations of Explosive Forming, Electro-hydraulic Forming, Electro-magnetic Forming. High Velocity Forming – Principles and Operations of Petro-forging, Dynapak.

Unit-IV – Press Working:

Introduction – Different types of Press and Selection of Presses – Press safety devices – Press Operations - Stock and Pattern layout – Press working dies – Principles and Operations of Cutting/Shearing and Deep drawing operations – Cutting and drawing dies – Design considerations – Defects in sheet metal formed parts.

Unit-V – Surface Finishing Operations:

Introduction – Classification – Principle and Operations of Lapping, Honing, Super finishing, Polishing, Buffing, Tumbling and Burnishing.

Unit-VI – Manufacture of threads and gears:

Threads manufacturing – Different methods – Casting, Thread Chasing, Thread Rolling, Die and Tapping, Milling and grinding.

Gear manufacturing - Different Methods – Casting, Forming and Metal removal. Gear Cutting and Generation Processes. Gear Finishing Operations

Unit-VII – Powder Metallurgy (P/M):

Introduction – Applications of P/M – Powder Characteristics – Powder production methods. Mixing and Blending, Briquetting techniques, Sintering. Infiltration and Impregnation. Cemented carbides. Advantages and Disadvantages of P/M.

Books:

8. Elements of Workshop Technology (Vol. I & II) – S.K. Hajra Coudhury and A.K. Hajra Coudhury.
9. A course in Workshop Technology (Vol. I & II) – B.S. Raghuwanshi
10. Manufacturing Science – Amitabha Ghosh and Asok Kumar Mallick, East West Press
11. Production Engineering – P.C. Sharma, S. Chand & Company Ltd.
12. Metal Forming Technology – Dr. R. Narayanasamy, Ahuja Book Co. Pvt. Ltd
13. Mechanical Metallurgy – G.E. Dieter, McGraw Hill

ME822: Industrial Engineering & Management (3-1-0)

Theory: 100 Sessional : 75 Time: 3hours

1. Organization: Definition of organization, organizational structure, types of organization, span of control, delegation of authority and responsibility.

2. Network Analysis: Objectives, Network development technique, Network computations – Critical Path and its significance, Earliest and Latest dates, calculation of float. Deterministic and probabilistic network models, Assumptions and computations related to PERT model, Crashing of jobs for minimum cost-time schedule for CPM models.

3. Work Study: (i) Meaning and scope, subdivisions of work study – Method/Motion study and Work Measurement **(ii)** *Method/Motion study*- its meaning and scope, steps in method/motion study, Tools and techniques of method/motion study, Principles of motion economy **(iii)** *Micro-motion study* – Meaning and scope, therbligs, use of motion camera in micro-motion study **(iv)** *Work measurement* – concept of observed time, rating/levelling factor, average worker and standard time for jobs. Use of *stop watch* and *work sampling* techniques in the determination of standard time.

4. Plant Location and layout: (i) Objectives, Locational factors, Economics of plant location **(ii)** Meaning, objectives and types of plant layout and their relevance to mass, batch and job-order production systems. **(iii)** Systematic Layout Planning (SLP) procedure **(iv)** Use of computers for layout design **(v)** Group Technology (GT), Flexible manufacturing systems (FMS) and Computer integrated manufacturing (CIM) **(iii)** Assembly Line Balancing (ALB) - meaning and objective, Heuristic methods for solution of ALB problems.

5. Product design and Development: (i) Meaning of product, Product life cycle (PLC) and Product mix **(ii)** Decisions to be taken during product development and design **(iii)** Procedure for product development and design **(iv)** Value of a product – its meaning, Value Analysis (VA) – its objectives, procedure and example, Simplification and Standardization.

6. **Production Planning and Control (PPC): (i)** Meaning and Objectives, Effects of types of production **(ii)** Steps in PPC primarily stressing the needs of marketing research, technological forecasting, process planning/routing, scheduling of flow-shop and job-shop productions, Use of Gantt chart, Machine loading, Make/Buy decision and Break-even analysis, Master production schedule, MRP and MRP-II, Supply Chain and Inventory management, Just In Time (JIT) and Kanban systems **(iii)** Production control – monitoring, expediting and re-planning.

(7) Maintenance Management: Meaning and Types of maintenance, and their suitability, Standards of maintenance, Total Productive Maintenance (TPM).

(8) Total Quality Management (TQM): (i) Meaning of Quality, Total Quality and Total Quality Management, Basic premises of TQM – customer satisfaction, process improvement, employee involvement, supplier partnership and management leadership. **(ii)** Tools and techniques for TQM **(iii)** Quality system and Quality assurance - ISO 9000 standards.

Recommended books:

1. Industrial Engineering – M Telsang
2. Essentials of Management – Koontz O' Donnel
3. Industrial engineering – M Mahajan
4. Production planning & control – L C Jhamb
5. Operations Management – Panneerselvam
6. Operations Management - Chezy
7. Motion and Time study – R M Barnes
8. Systematic layout planning – R Muther
9. Product design and manufacturing – Chitale and Gupta
10. Network and project management – Punmia
11. PERT & CPM – Weist and Levy
12. Production, operations and computer integrated manufacturing – M P Groover
13. Total Quality Management – Besterfield et.al.
14. Industrial Engineering and Management - O P Khanna.
15. Operation Management - BUFFA (John Wiley)
16. Elements of Production Planning and Control - EILON (McMillan)
17. Production , Planning and inventory control - P J Billington (PHI, 2nd Edition,1995)

18. Industrial Organisation and Management - BETHEL, AFWATER, SMITH, STACHKMAN.

ME823: INTERNAL COMBUSTION ENGINES(3-1-1)

Theory: 100 Sessional: 75 Time: 3Hours

Fuel Air cycle – effect of variation of specific heats, fuel-air ratio, compression ratio and dissociation. Actual cycle – losses in actual cycle.

Exhaust gas analysis – its interpretation and use in determination of combustion characteristics; Pollution norms.

I C engines fuels - - Petrol, Diesel, natural gases and some other alternative fuels and their characteristics and use in engines. Combustion process in S. I. And C. I. engines, abnormal combustion, detonation and fuel knock – additives. Rating of I. C. engine fuel.

Design features of combustion chambers used in S I and C I engines, some important types of combustion chambers.

Carburetion – desirable characteristics – compensation for simple jet carburetor, calculation for air-fuel ratio.

Injection processes – requirements and methods –mechanical, electronic and MPF injection system.

Ignition processes in petrol engines – requirements and types – battery magneto and electronic.

Performance characteristics of petrol and Diesel engines. Part load and full load characteristics in respect to thermal efficiency, mechanical efficiency, fuel consumption, bmep and torque. I C engine ratings and volume capacity compression ratio and weight to power output ratio and its trends in power – weight characteristics. Supercharging of I C engines – effect of supercharging on Diesel and petrol engines – performance characteristics for supercharged engines.

Supercharger – types, principles of duel-fuel and multi-fuel engines and Stratified combustion engines.

Recommended books:

1. A course in Internal Combustion engines – by M. L. Mathur and R. P. Sarma
2. Internal Combustion Engine fundamentals – by John B. Heywood-McGraw-Hill international edition.(1988)
3. Internal Combustion engines by V. Ganesan-Tata McGraw –Hill Publishing.-2nd edition(2003)
4. Engineering Fundamentals of Internal Combustion Engine by W.W. Pulkrebek, Pearson Education.
5. Fundamentals of Internal Combustion Engine by H.N.Gupta

ME824(Elective III): AIR – CONDITIONING(3-1-0)

Theory: 100 Sessional: 75 Time: 3Hours

Psychrometry: Psychrometric properties, representations of properties in charts, preparation of charts.

Psychrometric processes: Constant sensible heat and latent heat processes, adiabatic saturation and enthalpy deviation. Adiabatic mixing of air stream. Humidification, Dehumidification water spray processes, sensible heat factors, grand sensible heat ratio lines, apparatus dew points, Bypass factors, Air washer-humidifying efficiency.

Comfort A/C: Air temperature, human health, body temperature regulation, comfort indices, comfort charts and their limitations.
Load analysis: Inside and outside design conditions, load classification, summer cooling loads, solar heat gain and transmission and radiation. Flywheel effect of building materials, equipment temperature differential loads due to human beings, load due to electric light, equipments and appliances. Infiltrator and ventilator loads, product loads, miscelleneous loads such as duct heat gain, duct air leakage, fans, pumps etc. Winter heat load – computation of loads.
Duct design and Air distribution: Different methods of duct design such as velocity reduction, equal friction and static regain, aspect ratio duct losses, distribution of air in rooms, nature and supply grill; duct arrangement and air handling system.
A/C System: Unitary control system, special features of residential, commercial and industrial A/C system, Uear roun a/c zoning.
Equipments: (1) Fans – types of fans, characteristics, curves, fan selection. (2) Air filter and cleaner. (3) Cooling towers, evaporators, condensers (4) Cooling coils and water capacity, (5) Chemical dehumidifiers, (6) Heaters, radiators, Convection coils.
Instruments and controls: Temperature, humidity, air velocoty measuring instruments, Thermostat, humidiostat. By pass and damper control. Dew point control, noise control, Pneumatic control.
Books: 1.Refrigeration and Air-Conditioning by Ahmedul Ameen, PHI
2. Refrigeration and Air-Conditioning by C.P.Arora, Tata McGraw Hill Publication.
3. Refrigeration and Air-Conditioning by M.Prasad

ME 825(Elective IV): POWER PLANT TECHNOLOGY(3-1-0)

Theory: 100 Sessional: 75 Time: 3Hours

UNIT I : Introduction, power plants, types of power plants, requirements of plant design, Resources and development. Concepts of captive power plant and co-generation.
UNIT II : Power plant lay-out and economics, general design of power plant, unit plant station, cost of energy, selection of types of generator, selection of equipments, performance and operating characteristics, Load division, Tariff methods.
UNIT III : Steam Power Plants : Site selection, General lay-out of thermal power plants, Steam generation – high pressure boiler, Economiser, Superheater, Reheater, Regenerator, Super-critical cycles, efficiency and heat rate, Air preheater, Fuel handling equipments, coal firing furnace, fluidised bed combustion. Ash handling systems, Cooling tower and ponds. Steam turbines and ponds. Steam turbines – Installations, testing and maintenance, trouble shooting, Optimisation of power plant operating efficiency, Emission control.

UNIT IV : Diesel Power Plants: Introduction, plant lay-out, Engine performance, hea balance, Installation and maintenance of Diesel Engines, advantages, trouble shooting, methods of starting.
UNIT V : Gas turbine plants : Site selection, layout, installation maintenance, inspecting governing, fuels, materials, combined cycle, waste heat boiler.
UNIT VI: Hydroelectric Power Plants: Classification, types, governing, installation, operation and maintenance.
UNIT VII: Nuclear Power Plants : Fission and fusion, Thermal fission reactors, types of plants, fast breeding reactors.

UNIT VIII: Measurement and instrumentation : Importance, water purification and gas analysis.
UNIT IX : Environment aspects : Thermal pollution, Greenhouse effect, Acid precipitation, Radioactivity, Noise pollution, methods of reduction of pollution.
UNIT X: Non-Conventional Power Plants: Introduction to non-conventional non-polluting types – geothermal, wind, solar power plants and direct energy conversion systems.

Books recommended:

1. Power Plant Technology by Wakil , Tata-McGrow Hills.
2. Power Plant Engineering by G R Nagpal, Khanna Publishers.
3. Power Plant Engineering by S. Domkundwar, Dhanpat Rai and Sons.

ME 826L: PROJECT – II (0-0-12)

Sessional marks: 150
Pass marks: 75

Under this course the students are required to submit a project report on Mechanical Engineering topics. The report should be submitted in a standard FORMAT prescribed by the department .

ME 827L: VIVA – VOCE

Total marks: 75
Pass marks: 38

A final semester viva voce examination will be held at the end of B.E.8th semester examination. The viva voce will be to assess the student on his/her overall knowledge of the subjects related to Mechanical Engineering in addition to the project works he/she had undertaken in 7th and 8th semester.