(New Syllabus(Effective from July,2010)

All Theory papers are 3-1-0(i.e, 4 contact Hrs. per week) having 4 credits

All Sessionals are 0-0-3(i.e, 3 contact Hrs. per week) having 2 credits

1st & 2nd Semester(Same for all branches)

(Theory)

BME 101-Engineering Mechanics

Module - I

1. **Concurrent forces on a plane**: Composition, resolution and equilibrium of concurrent coplanar forces, method of moment, friction (chapter 1). (7 pds.)
2. **Parallel forces on a plane**: General case of parallel forces, center of parallel forces and center of gravity, centroid of composite plane figure and curves(chapter 2.1 to 2.4) (4)

Module - II

3. **General case of forces on a plane**: Composition and equilibrium of forces in a plane, plane trusses, method of joints and method of sections, plane frame, principle of virtual work, equilibrium of ideal systems.(8)
4. **Moments of inertia**: Plane figure with respect to an axis in its plane and perpendicular to the plane, parallel axis theorem(chapter 3.1 to3.4, 5.1, appendix A.1 to A.3) (3)

Module - III

5. **Rectilinear Translation:** Kinematics, principle of dynamics, D Alembert's Principle, momentum and impulse, work and energy, impact (chapter 6). (11)

Module - IV

6. **Curvilinear translation:** Kinematics, equation of motion, projectile, D Alembert's principle of curvilinear motion. (4)
7. **Kinematics** of rotation of rigid body (Chapter 9.1) (3)

Text book:

1. Engineering mechanics: S Timoshenko & Young; 4th Edition (international edition) MC Graw Hill.

Reference books:

1. Fundamental of Engineering mechanics (2nd Edition): S Rajesekharan & G Shankara Subramanium; Vikas Pub. House Pvt ltd.
2. Engineering mechanics: K.L. Kumar; Tata MC Graw Hill.

1st & 2nd Semester(all branches)

(Sessional)

BME 191-Workshop Practice - I

Workshop Practice-I consists of 3 sections **:**

1. **Carpentry Section** : Wooden rack/bench/chair/stool(any one)
2. **Fitting Section** : Paper Wt. Square or Rectangular joint(male and female joint) (any one)
3. **Black Smith Section** : Weeding hook/Hexagonal headed bolt blank(any one)

Third & Fourth Semester (M)-Theory

BME 202 : Manufacturing Science & Technology – I(M)

A. Casting Processes:

Module – I

1. **Sand Casting Process** : Introduction, pattern-types , materials , allowances ; moulding sand-composition , properties , testing; Core - core material(core sand) , properties of core materials , types of core , core prints ; chaplets , moulding types , moulding procedures , gating system: gates , riser , design of gating system for simple casting shape , Melting and furnaces for ferrous and non ferrous metals : Basic idea in cupola , induction furnace and Electric arc furnace ;Charge calculation. Degasification ,Solidification & Cooling of casting. (12)

Module – II

2. **Special Casting Processes** : Continuous casting process , Precision Investment casting process , Centrifugal casting process , Die casting , Shell mould casting , Permanent mould casting , Pressure casting process , Squeeze casting . Casting cleaning, Casting defects and remedial measures, Inspection of casting . (8)

B. Welding and Cutting Process :

Module – III

3. **Fusion Welding**: Principles of welding , brazing , soldering and adhesive bonding , Physics of welding , Types of welded joints , Joint design preparation. (2)

   Oxyfuel gas welding : Fuel gases , Types of flames , Welding equipments Welding techniques.(2)

   Electric arc welding : Principle of arc , Arc welding , Arc welding equipments , Electrodes , Manual metal arc welding , Carbon arc welding . (3)

   TIG and MIG welding , Submerged arc welding , Plasma arc welding , Electro-slag welding , Thermit welding , Electron beam welding , Laser beam welding , Under water welding .

   Welding defects & testing, weldability of metal , Welding safety (3)

   Cutting: Oxyfuel gas cutting , Arc cutting ,Plasma cutting (2)

Module – IV

4. **Conventional Machining Processes & Machine tools :** Turning drilling, shaping planning, milling, grinding, centreless grinding and broaching processes, machine tools used for these processes, their specifications & various techniques used. Indexing mechanism & methods. Finishing & super finishing processes, Production Machine tools – Capstan & Turret lathes**.** (8)

Text Books:

1. Manufacturing Technology vol.I , (Foundry Forming and Welding) by P.N.Rao , 3rd edition TMH
2. Manufacturing Technology vol.II , by P.N.Rao , 3rd edition TMH
3. Machining and Machine Tools by A.B.Chottopadhaya, Wiley Pub.
4. Manufacturing Engineering & technology , by S.Kalpakjain and S.R.Schmid , 4th edition low price

Reference Books :

1. Principle of Metal Casting , by R.W.Heine C.R.Loper and P.C.Rosenthal , 2nd edition TMH
2. Welding and Welding technology by R.L.Little , TMH
3. Welding Engg. & Technology by R.S. Parmar, Khanna Pub.

BME 203 : Mechanics of Solids (M)

Module – I

1. Definition of stress, stress tensor, normal and shear stresses in axially loaded members.

Stress & Strain :- Stress-strain relationship, Hooke's law, Poisson's ratio, shear stress, shear strain, modulus of rigidity. Relationship between material properties of isotropic materials. Stress-strain diagram for uniaxial loading of ductile and brittle materials. Introduction to mechanical properties of metals-hardness,impact.

Composite Bars In Tension & Compression:-Temperature stresses in composite rods – statically indeterminate problem. (10)

Module – II

2. **Two Dimensional State of Stress and Strain**: Principal stresses, principal strains and principal axes, calculation of principal stresses from principal strains.Stresses in thin cylinder and thin spherical shells under internal pressure , wire winding of thin cylinders.
3. **Torsion** of solid circular shafts, twisting moment, strength of solid and hollow circular shafts and strength of shafts in combined bending and twisting. (10)

Module – III

4. **Shear Force And Bending Moment Diagram**: For simple beams, support reactions for statically determinant beams, relationship between bending moment and shear force, shear force and bending moment diagrams.
5. **Pure bending** theory of initially straight beams, distribution of normal and shear stress, beams of two materials.
6. Deflection of beams by integration method and area moment method. (12)

Module – IV

7. Closed coiled helical springs.
8. **Buckling of columns :** Euler's theory of initially straight columns with various end conditions, Eccentric loading of columns. Columns with initial curvature. (8)

Text Books-:

1. Strength of materials by G. H. Ryder, Mc Millan India Ltd.,
2. Elements of Strength of Materials by S.P. Timoshenko and D.H. Young, East West Press Pvt. Ltd.,

Ref. Books:-

1. Introduction to solid mechanics by H. Shames, Prentice Hall India, New Delhi
2. Engineering mechanics of solid by E. P. Popov, Prentice Hall India, New Delhi
3. Engineering physical metallurgy, by Y. Lakhtin, MIR pub, Moscow.

BME 204: Engineering Thermodynamics(E,EEE,MS)

Module – I

1. **Basic Concepts**:- Thermodynamic systems and surrounding, state properties, processes and cycles. Thermodynamic equilibrium, heat and work transfer across boundaries, Quasi-static processes.
2. **First Law of Thermodynamics** :- First law for a closed system undergoing a cycle and undergoing a change of state. Internal energy as a system properties. Application of first law to different thermodynamic processes. (10)

Module – II

3. **Second Law Of Thermodynamics** :- Reversible and irreversible processes. Refrigerator and heat pump. Equivalence of Kelvin-Plank and Clausis statements, Carnot theorem and its efficiency. Inequality of Clasius and entropy concept. Change of entropy for various thermodynamic processes.
4. A**ir Standard Cycle & Introduction to I.C. Engine**: Otto, diesel and dual cycles, description and operation of four and two stroke cycle engine, comparison of SI and CI engines, valve timing diagram, power output and efficiency calculation. (10)

Module – III

5. **Steam And Steam Generator** :- Properties of steam, measurement of dryness fraction, use of steam table. T-S and H-S diagrams for representing thermodynamic processes.Boiler,Classification of boiler, comparison between water tube boiler and fire tube boiler. Boiler mountings and accessories. Description of Cochran & Babcock -Wilcox boiler.
6. **Steam Nozzles** :- Types of nozzles, isentropic flow through nozzles, effect of friction on nozzle efficiency. Critical pressure ratio and maximum discharge, throat and exit area. (10)

Module – IV

7. **Steam Turbines & Condensers**:- Turbine type and applications. Impulse turbine, pressure and velocity compounding, velocity diagram, work output, losses and efficiency. Impulse reaction turbine, velocity diagram, degree of reaction, work output, losses and efficiency. Jet and surface condensers. Condenser vacuum and vacuum efficiency.
8. **Heat Transfer** : Basic modes of heat transfer, one dimensional steady state, conduction through slab,cylinder and sphere ; basic theory of radiant heat transfer, black body & mono chromatic radiation, total emissive power.

Text Book:

1. Engineering Thermodynamics by P.K.Nag, TMH

BME 205 : Materials Engineering (M)

Module – I

1. Classification of engineering materials, structure of metals and alloys,Properties of engineering materials. (3)
2. Mechanism of Crystallization, Crystal imperfection, plastic deformation by slip and twining . . Effects of cold working on properties, Review of strengthening methods. (5)

Module - II

3. **Constitutions of Alloys** :-Pure metal, Intermediate alloy phase , solid solution: Substitutional and interstitial. (4)
4. **Phase Diagram**:-Binary phase diagram, phase diagram rules, iron-carbon equilibrium diagram, phase transformation in iron-carbon system. (6)

Module - III

5. **Heat Treatment of Steels** :-Annealing:different types of annealing , Normalizing,Hardening: isothermal transformation(TTT) diagram , different cooling curves and transformation on continuous cooling, Tempering, sub-zero treatment of steel, Defects due to heat treatment. (7)
6. **Surface Hardening of Steels**:-Induction hardening, Flame hardening, Case hardening: Carburizing, Nitriding, Cyaniding, carbonitriding, Diffusion coating. (4)

Module - IV

7. **Introductory Ideas On Ferrous Alloys**:-Steel and cast iron-basic differences, Effect of alloying elements on the properties of steels, general classification of steels : carbon steels- types, Alloys steels-nickel steel, chromium steel, manganese steel, wear resistant steel, Corrosion resistant steels, Stainless steels, Tool steels, Steel designation, cast iron-types of Cast Irons.(7)
8. **Nonferrous Alloys**:-Plastics, Ceramics, Composite materials, common applications of various materials. (4)

Text Books:

1. Material Science and Engg,5th Ed,by V.Raghvan,PHI.
2. Introduction to Physical Metallurgy,2nd Ed, by S.H.Avner, TMH.
3. Engineering Physical Metallurgy, by Y. Lakhtin, MIR pub, Moscow.

Reference Books:

1. Material Science and Engg 6TH Ed, W.D. callister,Jr., John wiley &son
2. Introduction to Material Science for engineers, 3rd Ed, J.F. shackleford,PHI.
3. Foundation of materials science and engineering, 2nd Ed.W.F.smith, TMH.

BME 206 : Basic Thermodynamics(M)

Module – I

1. **Basic Concepts**:- Thermodynamics system and surroundings, state, properties, processes and cycles. Thermodynamic equilibrium, heat and work transfer across boundaries, Quasi-static processes. (4)
2. **First Law of Thermodynamics** :- First law for a closed system undergoing a cycle and undergoing a change of state. Internal energy as a system properties. Application of first law to different thermodynamic processes.First law applied to flow processes, mass and energy balance in a simple flow process, variable flow process, discharging and charging of a tank.(6)

Module – II

3. **Second Law of Thermodynamics** :- Reversible and irreversible processes. Refrigerator and heat pump. Equivalence of Kelvin-Plank and Clausis statements, Carnot cycle and its efficiency, Carnots Theorem. Inequality of Clasius and entropy concept. Change of entropy for various thermodynamic processes. Temperature entropy diagram. (5)
4. **Available Energy, Availability And Irreversibility**: Available energy, referred to cycle, quality of energy, maximum work in a reversible process, reversible work by an open system exchanging heat only with the surroundings, useful work, dead state and availability. (5)

Module – III

5. **Steam And Steam Generator** :- Properties of steam, measurement of dryness fraction, use of steam table. T- S and H-S diagrams for representing thermodynamic processes. Classification of boiler, comparison between water tube boiler and fire tube boiler. Boiler mountings and accessories. Description of Cochran, Babcock and Wilcox boilers. (10)

Module – IV

6. **Air Standard Cycle & Introduction to I.C. Engine**: Otto, diesel and dual cycles, description and operation of four and two stroke cycle engine, comparison of SI and CI engines, valve timing diagram, power output and efficiency calculation. (6)
7. **Reciprocating Air Compressor**: Work required for single and double stage air compressors, effect of intercooling, optimum interstage pressure, effect of clearance on volumetric efficiency.(4)

Text Book:

1. Engineering Thermodynamics by P.K.Nag. TMH

Sessional

Third & Fourth Semester :

BME 291: Mechanics and Materials testing lab(M,E,EEE)

A. Mechanics

1. Determination of rigidity modulus of a given wire .
2. Dermination of M.I of a fly wheel.
3. Study of Epicyclic gear train.
4. Determination of mechanical advantage & velocity ratio of various lifting machines .

B. Materials testing lab

1. Determination of tensile strength of ductile material using UTM.
2. Determination of hardness number of different materials using Rockwell hardness testing machine.
3. Ericson cupping test and impact test for 3different specimen.
4. Fatigue Test of a given specimen

BME 292 : Materials Testing Lab. (C)

1. Determination of tensile strength of a ductile material using UTM.
2. Determination of compressive strength of cast iron .
3. Determination of hardness number of different materials using Rockwell hardness testing machine.
4. Ericson cupping test and impact test for 3different specimen.
5. Fatigue Test of a given specimen
6. Flaw detection of a given specimen using ultrasonic method.

BME 293: Machine Drawing (M,MS)

Screw threads,Screwed fastening,Keys,Cotter joints,Knuckle joints, Rivetted joints,Flange coupling,Engine parts,Introduction to computer graphics, computer aided drawing.

Fourth Semester :

BME 294 : Workshop Practice –II(M)

Foundry shop : 1. Sand casting with core

2. Study of cupola and other furnaces

Welding shop : 1. Gas welding & Arc welding with small job.

2. Study of MIG,TIG & spot welding

3. Brazing & soldering practices

BME 295: Internal Combustion(IC) Engine and Foundry Lab. (M)

A. IC Engine:

1. Study of IC engine(cut model).
2. Study of Cochran Boiler .
3. Load test on Rusten Diesel Engine .
4. Performance test on two stage reciprocating air Compressor .

B. Foundry :

1. Determination of Grain Fineness Number(GFN) of a given moulding sand .
2. Determination of permeability number and compressive strength of a given moulding sand .
3. Determination of clay content of a given moulding sand .
4. Determination of moisture content of a given moulding sand .

BME 296: Metallographic Study & Non Destructive(ND) Testing (M)

A. Metallographic Study :

1. Sample(mild steel and cast iron) preparation .
2. Microstructure study of a steel specimen using metallographic microscope.
3. Microstructure study of a cast iron specimen using metallographic microscope.

B. ND Testing :

1. Flaw detection by ultrasonic method.
2. Flaw detection by Eddy Current method.
3. Detection of surface defect by magnetic particle test
4. Detection of surface defect by liquid penetration method

BME 297 : Mechanical Engg. Measurement Lab. (M)

A.
1. Measurement of displacement using LVDT
2. Inspection of gear tooth using Tool Makers Microscope
3. Dimension(internal & external) measurement of a specimen using slip gauges
4. Height difference measurement between two slip gauges using optical flat .

B.
1. Burden tube pressure gauge
2. Temperature measurement using thermo couple
3. Flow measurement using Rotameter & speed measurement by Tachometer
4. Pressure measurement using various types of manometer .

BME 298 : Thermal & Materials Testing lab. (MS)

A. Thermal

1. Study of IC engine(cut model)
2. Study of Modern carburetor
3. Study of Fuel Injection system of diesel engine.
4. Study of power Transmission system.

B. Materials testing lab

1. Determination of tensile strength of ductile material using UTM.
2. Determination of hardness number of different materials using Rockwell hardness testing machine.
3. Ericson cupping test and impact test for 3 different specimen.
4. Fatigue Test of a given specimen

Fifth Semester- Theory:

BME 307: Fundamentals of Fluid Mechanics(M)

Module – I

1. **Introduction**: Physical properties of fluids, Density, Specific weight, Specific volume, Specific gravity, Compressibility, Elasticity, Surface tension, Capillarity, Vapour pressure, Viscosity, Ideal and real fluids, Concept of shear stress, Newtonian and Non Newtonian Fluids. (5)
2. **Fluid Statics**: Pressure-Density-Height relationship, Manometers, Pressure on plane and curved surface, Centre of pressure, Buoyancy, Stability of immersed and floating bodies, Fluid masses subjected to uniform acceleration, Free and Forced vortex. (5)

Module - II

3. **Fluid Kinematics**: Steady and Unsteady, Uniform and Non-uniform, Laminar, Turbulent flows and Enclosed flows, Definition of One, Two and Three dimensional flows, Streamlines, Streaklines and Pathlines, Stream tubes, elementary explanations of stream function and velocity potential, Basic idea of flow nets. (6)
4. **Fluid Dynamics**: Basic Equations- equation of continuity, One-dimensional Euler's equations of motion and its integration to obtain Bernoulli's equation and Momentum equation. (4)

Module - III

5. **Flow through pipes (Incompressible Flow)**: Laminar and turbulent flows in pipes- Hydraulic mean radius, Concept of friction loss, Darcy-Weisbach equation- Moody's diagram, Flows in sudden expansion and contraction, Minor losses in fittings, Branched pipes in parallel and series, Transmission of power, Water hammer in pipes, Sudden closure condition. (10)

Module - IV

6. **Open Channel Flow**: Definition, Uniform flow, Chezy's, Kutter's and Manning's equations, Channel of efficient cross section, Concept of specific energy. (5)
7. **Measurements**: Hook Gauge, Point gauge, Pilot gauge, Current meter, Venturimeter, Orifice meter, Orifices and mouthpieces, Notches and weir.(5)

Reference Books :

1. Fluid Mechanics and Hydraulic Machines by Modi and Seth, Standard Book House, New Delhi

BME 308 : Fluid Mechanics & Fluid Power Engg. (MS)

Module - I

1. **Introduction**: Physical properties of fluids, Density, Specific weight, Specific volume, Specific gravity, Compressibility, Elasticity, Surface tension, Capillarity, Vapour pressure, Viscosity, Ideal and real fluids, Concept of shear stress, Newtonian and Non Newtonian Fluids. (5)
2. **Fluid Statics**: Pressure-Density-Height relationship, Manometers, Pressure on plane and curved surface, Centre of pressure, Buoyancy, Stability of immersed and floating bodies, Fluid masses subjected to uniform acceleration, Free and Forced vortex. (5)

Module - II

3. **Fluid Dynamics**: Basic Equations- equation of continuity, One-dimensional Euler's equations of motion and its integration to obtain Bernoulli's equation and Momentum equation. (4)
4. **Dimensional Analysis and Principles of Model Testing** : Dimensional homogeneity, Dimensional analysis, Rayleigh's method and Buckingham Theorem. Similarity laws and model studies. Distorted models.(4)

Module - III

5. **Drag and lift** : Drag and lift coefficient, pressure drag and friction drag on stream lined body and bluff body. Boundry layer separation & its control. Drag over flat plate. Profile drag. Drag characteristics of sphere , cylinder and disc .Circulation and lift on a circular cylinder,magnus effect. Circulation and lift on a Airfoil.(6)
6. **Hydraulic Turbines**: Classification of turbines, Different heads and efficiencies of turbines, Study of Pelton , Francis and Kaplan turbines, Specific speed and unit quantities, performance of turbines, Governing of turbines, Cavitations in reaction turbines, Principles of similarity applied to turbines.(6)

Module - IV

7. **Centrifugal Pump**: Principle , classification, pressure changes in a pump .Velocity vector diagrams and work done, minimum speed of pump to deliver liquid, multistage pumps. Similarity Relations and specific speed.(6)
8. **Reciprocating pump**: Principle of working, slip, work done, effect of acceleration and frictional resistances, separation, air vessels.(4)

Reference Books :

1. Fluid Mechanics & Hydraulics Machines –By:Modi and Seth, Standard Book House,New Delhi
2. Fluid Mechanics & Hydraulic Machines- By Dr.R.K.Bansal Laxmi Pub.(p) Ltd.)
3. Introduction to Fluid Mechanics & Fluid Machines – By S. K .Som & G .Biswas, TMH Pub. (p) Ltd
4. A Textbook of Fluid Mechanics and Hydraulic Machines by Dr. R K Bansal, Laxmi Pub.
5. Fundamentals of Fluid Mechanics by Som & Biswas, TMH.

BME 309: Machine Dynamics-I (M)

Module - I

1. **Mechanisms**: Basic kinematic concepts & definitions, mechanisms, link, kinematic pair, degrees of freedom, kinematic chain, degrees of freedom for plane mechanism, Gruebler's equation, inversion of mechanism, four bar chain & their inversions, single slider crank chain, double slider crank chain & their inversion. (8)

Module - II

2. **Kinematics analysis**: Determination of velocity using graphical and analytical techniques, instantaneous centre method, relative velocity method, Kennedy theorem, velocity in four bar mechanism, slider crank mechanism, acceleration diagram for a slider crank mechanism, kleins construction method, rubbing velocity at pin joint, coriolli's component of acceleration & it's applications.(12)

Module - III

3. **Inertia force in reciprocating parts**: Velocity & acceleration of connecting rod by analytical method, pison effort, force acting along connecting rod, crank effort, turning moment on crank shaft, dynamically equivalent system, compound pendulum, correction couple, friction, pivot & collar friction, friction circle, friction axis.(6)
4. **Friction clutches**: Transmission of power by single plate, multiple & cone clutches, belt drive, initial tension, Effect of centrifugal tension on power transmission, maximum power transmission. (4)

Module - IV

5. **Brakes & dynamometers**: Classification of brakes, analysis of simple block, band & internal expanding shoe brakes, braking of a vehicle, absorbing & transmission dynamometers, prony brakes, rope brakes, band brake dynamometer, belt transmission dynamometer & torsion dynamometer.(7)
6. **Gear trains**: Simple trains, compound trains, reverted train & epicyclic train. (3)

Text Book :

1. A text book of theory of machine by R.K Bansal & J.S. Brar, Laxmi Publication Pvt.Ltd.

Reference Books :

1. Theory of machines, by S.S Ratan,TMH
2. Theory of machine by Thomas Bevan, TMH

BME 310 : Machine Design-I (M)

(Data Books are allowed)

Module - I

1. **Introduction to machine design**: Stages in design , standardization interchangeability, strength, rigidity, engg. materials, ferrous, nonferrous ,Indian standard specification for ferrous materials, allowable stress, factor of safety.(10)

Module - II

2. **Design of joints**: Revetted , welded and bolted joints based on different types of loading , illustrative problems with solutions. Design of cotter joints with socket and spigot, with a gib , design of knuckle joint.(12)

Module - III

3. **Design of shaft** : Solid and hollow shaft based on strength and on rigidity design of key and pins, design of couplings-only protective type of solid flange coupling . (8)

Module - IV

4. **Design of Spring** : Helical, leaf springs.
5. Design of belt, rope and chain drives and design of screw jack . Illustrative problems with solutions.(10)

Text books:

1. Machine Design by P.C. Sharma,D.K.Agrawal–Kataria And Sons
2. Mechanical Engg. Design by J.E.Shigley and I.C Mitchelle-–TMH
3. Any data book

Reference book:

1. Elements of machine design by Pandya & N.C.E Shah

BME 311: Manufacturing Science & Technology-II (M)

Module - I

1. Classification of Metal Machining Processes, Tool Materials, Types of Tools- Single Point & Multipoint, Tool Geometry And Nomenclature: ASA, ORS & NRS System, Effect of Tool Geometry and Effect of Machining Variables on Machining .(6)
2. Mechanism of Chip Formation, Shear deformation and shear plane Types of Chips, Factors Involved In Chip Formation , Effect of Cutting Variables on Chip Reduction Co-Efficient.(6)

Module - II

3. **Force System In Turning**: - Merchants circle diagram, velocity relationship and Resenberg relationship, stress in conventional shear plane. Energy of cutting process, restricted cutting, Ernst and merchant angle relationship, measurement of forces – dynamometers for measuring turning and drilling forces. (6)

Module - III

4. Evaluation of Machinability, Mechanism of Tool Wear, Tool Life, Taylors Tool Life Equations, Determination of Optimum Cutting Speed In Machining, Thermal Aspects Of Machining, Chip-Tool Interface Temperature, Cutting Fluids. Economics of machining. (6)
5. **Jigs & Fixtures**:- Principle ,type of Turning, Milling fixture and Drilling, Boring Jigs, Principles of Location And Clamping, Tool Guidance.(4)

Module - IV

6. Design of Single Point Cutting Tool, Form tool and Broach tool. (5)
7. **Non Conventional Machining Processes :** Principle, Process and application of AJM,EDM,ECM,LBM & USM.(5)
8. Principles of NC , CNC & DNC machines .(2)

Reference Books :

1. Metal Cutting Theory & Practice by A Bhattacharya, New Central Book Agency.
2. Metal Cutting Principles By M C Shaw, CBS publication.
3. Manufacturing Technology Metal Cutting And Machine Tools By P N Rao, TMH.
4. Manufacturing science by A Ghosh & A K Mallik, EWP PVT LTD
5. A Textbook Of Production Engineering By P C Sharma, S Chand Publications.
6. CNC Technology & Programming by Tilak Raj, Dhanpat Rai Publication.

BME 312: Metal Forming Processes (M)

Module - I

1. **Introduction** : Principle of plastic deformation and yield criteria , Fundamental of hot and cold working processes ,Effect of strain rate on forming process .(5)

2. **Rolling** : Principle of rolling , Rolling stand arrangement , Rolling load calculation, Roll passes , Flat rolling , Pipe rolling , Defects in rolled products .(5)

Module - II

3. **Forging** : Open die forging , Drop forging , Press forging , Forging design, allowances, die design for drop forging, design of flash & gutter, Upset forging die design,forging defects and inspection .(6)
4. **Extrusion** : Forward and backward extrusion , Hydrostatic Extrusion , Extrusion Forging , Extrusion of tubes , Calculation of force in hot extrusion , Effect of Extrusion Variables, Extrusion Defects (4)

Module - III

5. **Drawing :** Wire drawing , Rod and tube drawing , Drawing forces , Drawing defects.(2)

6. **Sheet Metal Forming & bending :** Sheet metal working-shearing, blanking piercing, deep drawing operation. Die design for sheet metal operations, progressive and compound die, strippers, stops, strip layout. Principle of bending, Spring back effect, Coining (8)

Module – IV

7. **Advanced forming processes :** High energy rate forming, explosive forming , electro hydro forming , electro magnetic forming, rubber die forming. (3)
8. **Powder Metallurgy Forming Process :** Method of Powder production , Powder characteristic analysis , Powder annealing , Precompaction studies , Cold compaction Studies , Sintering and sintering atmosphere , Post sintering operations(coining ,infiltration, hot forging etc.) Hot and cold iso-static pressing , Properties of P/M products and applications. (7)

Reference Books:

1. Manufacturing Technology by P.N. Rao Vol. 3 3rd Ed. TMH Publication
2. Manufacturing Engineering And Technology by S. Kalpakian and S. Schimid , Pearson Edn.

Sixth Semester(M) – Theory

BME 313 : Advanced Mechanics of Solids (M)

Module - I

1. Energy method based on strain energy due to bending: Strain energy due to axial load, bending moment & twisting moment, principle of virtual work, castiglianos theorem.(5)

   Maxwell's theorem of reciprocal relations. Unit load and unit couple method for determining deflection and slope . (5)

Module - II

2. Thick walled cylinder: Thick cylinders subjected to internal and external pressures, compound thick cylinder.(6)
3. Unsymmetrical bending: Properties of beam cross section , slope of neutral axis, stresses & deflection in unsymmetrical bending, shear centre.(6)

Module - III

4. Curved beam: Bending of beam with large initial curvature, stess distribution in beam with rectangular, circular, trapezoidal cross section, stresses in crane hooks, ring & chain links.(8)

Module - IV

5. Advanced topics in strength of materials: Repeated stresses & fatigue in metals, concept of stress, concentration, notch & stress concentration factor, concept of creep.(6)
6. Elementary concept of elasticity: stresses in three dimension, equation of equilibrium & compatibility.(4)

Text Books:

1. Advanced Mechanics of Materials by Seely & Smith , John Wiley, New york
2. Advanced Mechanics of Solids by L.S.Srinath,TMH.

Reference Book:

1. Advanced mechanics of materials, Kumar and Ghai, Khanna pub.

BME 314 : Heat Transfer (M)

Module - I

1. I**ntroduction**: Modes of heat transfer, basic laws of heat transfer , combined heat transfer mechanism, analogy between flow of heat and electricity, Unit and dimension.(2)

2. **Conduction**: Derivation of three dimensional Fourier conduction equation in Cartesian coordinates, transformation of Fourier equation into polar coordinates. One dimensional steady state conduction through slab, cylinder, sphere and composite medium, critical insulation thickness. Effect of variable thermal conductivity. Heat transfer through rectangular and pin fins. Fin effectiveness and fin efficiency. Solution of fin equation for different boundary condition. Effect of fin on heat flow, Fin arrangements. Solution of fin problems using numerical techniques. Introduction to two dimensional steady state heat conduction. Analytical method for solving two dimensional heat conduction problems.(10)

Module - II

3. **Convection**: Hydrodynamic and thermal boundary layer for laminar flow over a flat plate. Integral solution of boundary layer equation for laminar flow over a plate. Heat transfer for laminar flow in tubes. Mechanism of heat transfer in turbulent flow, Reynolds analogy. Laminar free convection boundary layer equation for flow over a vertical plate and approximate solution of these equations. Dimensional analysis applied to forced and free convection.(8)

Module - III

4. **Empirical correlation** : Correlation for external flow – laminar and turbulent. Correlation for heat transfer to liquid metals. Correlation for free convection heat transfer.(5)

5. **Boiling and Condensation**: Film and drop wise condensation Nusselt's theory of laminar film condensation, pool boiling regimes, nucleate boiling, film boiling , peak heat flux, Rohsenow correlation for nucleate boiling.(5)

Module - IV

6. **Radiation**: Basic theories of radiant heat transfer. Black body and monochromatic radiation, total emissive power. Stephen Boltzmann law. Grey body. Kirchhoff's law. Wien's displacement law. Radiation between two black bodies, shape factors for simple geometries, radiation between two grey bodies, electrical network method for solving radiation problems, radiation shields.(5)

7. Heat exchangers: Types of heat exchangers, Overall heat transfer coefficient. Fouling factor, logarithmic mean temperature difference, effectiveness, Number of Transfer Units , heat exchanger design.(5)

Text Book:

1. Heat transfer by J.P. Holman, TMH (P) Ltd.

Reference Book :

1. Fundaments 0f Heat and Mass Transfer by R. C. Sachdeva (New Age International (P)Ltd.
2. Heat transfer- A basic approach by M. Niyati, Ozisik, MC Graw Hills.

BME 315 : Fluid Dynamics & Hydraulics Machines(M)

Module - I

1. **Dimensional Analysis and Principles of Model Testing** : Dimensional homogeneity, Dimensional analysis, Rayleigh's method and Buckingham Theorem. Similarity laws and model studies. Distorted models. (4)
2. **Boundary layer:** Boundary layer growth over a flat plate. Boundary layer thickness, Nominal thickness, displacement thickness, momentum thickness and energy thickness, laminar and turbulent boundary layer, Momentum integral equation using momentum principle. Boundary Layer Separation and its control. (6)

Module - II

3. **Drag and lift** : Drag and lift coefficient, pressure drag and friction drag on stream lined body and bluff body. Drag over flat plate. Profile drag. Drag characteristics of sphere , cylinder and disc .Circulation and lift on a circular cylinder,magnus effect. Circulation and lift on an Airfoil.(8)

Module - III

4. **Hydraulic Turbines**: Classification of turbines, Different heads and efficiencies of turbines, Study of Pelton , Francis and Kaplan Turbines, Specific speed and unit quantities, performance of turbines, Governing of turbines, Cavitations in reaction turbines, Principles of similarity applied to turbines.(10)

Module - IV

5. **Centrifugal Pump**: Principle , classification, pressure changes in a pump .Velocity vector diagrams and work done, minimum speed of pump to deliver liquid, multistage pumps. Similarity Relations and specific speed. (5)
6. **Reciprocating pump**: Principle of working, slip, work done, effect of acceleration and frictional resistances, separation, air vessels.(3)
7. **Miscellaneous machines** : Hydraulics - Intensifier , ram, coupling, press, accumulator & Air injection pump(4)

Reference Books :

1. Fluid Mechanics & Hydraulics Machines –By:Modi and Seth, Standard Book House
2. Fluid Mechanics & Hydraulic Machines- By Dr.R.K.Bansal Laxmi Pub.(p) Ltd.)
3. Introduction to Fluid Mechanics & Fluid Machines – By S. K .Som & G .Biswas, TMH Pub. (p) Ltd

BME 316 : Industrial Engineering & Operation Research(M)

Module - I

1. **Production Planning & Control**: Definition & Objectives, Aggregate Planning, Materials Requirement Planning, Routing Scheduling, Machine Loading Using Johnson's Rule, Dispatching.(5)
2. **Inventory Control**: Introduction, Relevant Costs, Basic EOQ Model, Models with Quantity Discount, Economic Batch Quantity, Periodic and Continuous Review System for Stochastic System, Safety Stock, Re-Order Point and Order Quantity Calculation, ABC Analysis.(6)

Module - II

3. **Project Management**: Project Management through PERT / CPM, Network Construction, CPM, Network Calculation, Crashing of Project Network, Project Scheduling with Limited Resources, Line-Of-Balance.(6)
4. **Modern Management System** : ISO-9000 Series ,Poke Yoke , Kaizen, Kanban , Quality Circle JIT TQM.(3)

Module - III

5. **Linear Programming**: Mathematical formulation of the problem, graphical solution method, general linear programming problem. (5)
6. **Simplex & Duplex Method**: Simplex method, introduction, fundamental properties of solution, computational procedure, concept of duality in simplex method, dual simplex algorithm.(5)

Module - IV

7. **Transportation Problem**: Matrix form of transportation problem, transportation table moving towards optimality, degeneracy in transportation problem.(4)
8. **Assignment & Routing Problem**: Assignment problem, assignment algorithm, routing problems.(4)
9. **Queueing Theory**: Introduction, classification, simple queueing model.(2)

Reference Books:

1. Industrial Engineering & Production Management by M Mahajan, Dhanpat Rai Publication.
2. Operation Research by Kanti Swaroop, P K Gupta & Manmohan, S Chand & Sons.

BME 317 : Machine Dynamics-II (M)

Module – I

1. **Toothed Gears**: Theory of shape and action of tooth properties and methods of generation of standard tooth profiles, standard proportion , interference and undercutting, methods for eliminating interference ,minimum number of teeth to avoid interference.(7)
2. **Gyroscope**:Gyroscopic couple, plane disc, analysis of forces on bearing due to forced precession of rotating disc mounted on shaft, gyroscopic effect on a two wheel and a four wheel vehicle ,gyroscopic stabilization(6)

Module - II

3. **Cams**: Simple harmonics, constant velocity and acceleration types, displacement, velocity and acceleration of follower ,cams with specified contours.(6)
4. **Governors**: Centrifugal governors – Watt and Porter governors ,spring loaded governors - Hartnell governors , sensitiveness ,stability isochronism, hunting , governer effort and power ,curves of controlling force , effect of friction .(6)

Module - III

5. **Balancing**: Balancing of revolving masses in one plane and different planes ,partial balancing of single cylinder ,engine balancing of multicylinder engine ,v and radial engine ,methods of direct and reverse cranks(5)
6. **Dynamics Of Machine**: Turning moment diagram ,flywheel.(3)

Module - IV

7. **Vibration** : Introduction to vibration, causes of vibration, elimination of vibration, types of vibration – longitudinal, transverse , torsional ; definition of terminology like natural frequency, amplitude , time period , free vibration, forced vibration, resonance, degree of freedom with examples , calculation of natural frequency of undamped single degree of freedom system by Newton's 2nd Law, D-Alembert's principle and energy method, Equivalent spring constant for the system having different types of combination of springs and calculation of their natural frequencies , calculation of natural frequency of single degree of spring – mass system taking mass of spring into account (7)

Text Books:

1. Theory of Machines by S S Ratan , TMH
2. Theory of machine by R K Bansal,Laxmi Pub. Pvt. Ltd.,

Reference Books:

1. Mechanism of Machine theory by Rao and Dulchipati, New Age Publication
2. Theory of Mechanism and Machine by Ghosh and Mallick ,East West Press

Sessional

Fifth Semesster (M)

BME 391 : Machine Dynamics & Fluid Mechanics Lab.(M)

A.Machine Dynamics lab

1. Determination of Torque & Brake Power using brake dynamometer.
2. Performance characteristics of spring loaded Governer.
3. Determination of critical speed of a rotating shaft.
4. Determination of Natural frequency under damped vibration (Torsional vibration).

B.Fluid Mechanics Lab. :

1. Flow measurement using Venturimeter.
2. Determination of Dracy Weisback coefficient for different pipe sizes.
3. Determination of Cd for rectangular weirs & notches.
4. Determination of Chezy's and Manning's constants.

BME 392 : Production Engg. (Metal cutting & forming) Lab. (M)

A. Metal Cutting Lab:

1. Determination of surface roughness of 3 diffferent specimen using Taylor Hobsons Talysurf.
2. Determination of cutting forces during turning operation using force dynamometer.
3. Determination of thrust and torque using drill tool dynamometer.
4. Demonstration of spinning operation.

B. Metal forming lab:

1. Comparison of loads in forward and backward extrusion processes.
2. Determination of load variations with different extrusion ratios.
3. Experiment on deep drawing.
4. Determination of friction factor in ring/disc compression test.

BME 393: Heat Power & Hydraulic Machines Lab. – II (MS)

1. Heat balance in Rusten Diesel Engine(single cyl.)
2. Study of modern Carburator
3. Study of fuel Injection system
4. Load test on variable compression ratio engine
5. Expt. On Reciprocating pump
6. Expt. On hydraulic ram
7. Pelton Turbine with generator loading.
8. Franci's Turbine with generator loading.

BME 394 Machine Design-I (sessional) (M)

Design and drawing of :

1. A pressure vessel.
2. Bolted joint.
3. Welded joint.
4. Cotter joint.
5. Knuckle joint.
6. Flexible coupling.
7. Screw jack.

BME 395 Workshop Practice –III (M)

1. **Turning shop** : A suitable job preparation with thread cutting and taper turning operations
2. **Machine shop** : Operation of different machines such as milling, shaper, planner

   Slotter , gear hobbing , surface grinder & radial drilling m/c

Sixth Semester(sessional)

BME 396: Heat Power Lab. (M)

1. Heat balance in Rusten Diesel Engine(single cyl.)
2. Morse test on BMC Petrol Engine
3. Study of modern Carburator
4. Study of fuel Injection system
5. Load test on variable compression ratio engine
6. Load test on variable injection pressure
7. Study of steam turbine plant.
8. Study of power transmission system in automobile.

BME 397 : Hydraulic Machines Lab. (M)

1. Study on different Runners and Impellers
2. Expt. On Reciprocating pump
3. Expt. On centrifugal pump
4. Expt. On hydraulic ram
5. Pelton Turbine with generator loading.
6. Franci's Turbine with generator loading.
7. Franci's turbine with brake loading.
8. Kaplan turbine with brake loading.

BME 398 : Advanced Production Engg. & Industrial Engg. Lab.(M)

A. Nonconventional Machining Processes

1. Expt. on EDM
2. Expt. on USM.
3. Expt. on AJM
4. Expt.on on ECM

B. I.E. Lab.

Calculation & preparation of various control charts .

BME 399 : Production Design & Production Tooling(PDPT)(M)

1. Design of single point cutting tool
2. Design of broach tool.
3. Design of form tool
4. Design of press tool
5. Design of limit gauges
6. Design of forging dies
7. Design of press tool
8. Design of deep drawing dies
9. Design of drilling jig
10. Production Process planning

Seventh Semester (M)-Theory

BME 418: Machine Design-II (M)

(Any data book is allowed)

Module - I

1. **Theories of failure**: Application of theories of failure to practical problems, dynamic stresses and stress concentration, design of machine members based on fatigue consideration, (Soderberg and Goodman criteria) notch sensitivity, S. C. F. (10)

Module - II

2. **Design of engine components**: Cylinders, piston, connecting rod, flywheel, crank shaft and valve.(12)

Module - III

3. **Design of transmission components**-: clutches(friction and centrifugal type), straight and helical spur gears, bevel gears and worm gears.(10)

Module - IV

4. Design of journal bearings based on hydrodynamic theory of lubrication, types of ball and roller bearing, dynamics and static load rating, selection of ball and roller bearings, properties of lubricants, viscosity and oiliness.(8)

Text Books:

1. Machine design, P. C. Sharma and D. K. Agrawal, Kataria & Sons
2. Any Machine Design data book

BME 419: Power Plant Engineering (M)

Module - I

1. **Introduction**:-Energy sources for generation of electric power, principal types of power plant, their special features and applications.(4)
2. **Steam Power Plant**: Selection of sites, general layout of modern steam power plant, high pressure boilers, super heater and air preheater, fluidised bed boilers, fuel and ash handling equipments, water treatment plant, spray ponds and cooling towers, steam condenser type and calculation.(6)

Module - II

3. **Steam Power Plant Cycles**: Rankine cycles, Modified Rankine cycles, reheat cycles, regenerative cycles.(4)
4. **Introduction To Steam Flow Through Nozzles, Steam Turbines:** Types of nozzles, Isentropic flow through nozzles, Effect of friction, Nozzle efficiency, Critical Pressure ratio and maximum discharge, throat and exit area. Classification, impulse and reaction turbines, difference between two, types of power in steam turbine, steam turbine governing and control.(6)

Module - III

5. **Nuclear Power Plant**: Classifications and essential component of nuclear reactor, heavy water moderator and cooled reactors, CANDU reactors, light water reactor, gas cooled reactors, liquid metal cooled reactors, disposal of nuclear waste.(8)

Module - IV

6. **Power Plant Economics**: Plant investment cost, fixed charges, operating costs, energy cost and depreciation, factors of affecting economics of the generation and distribution.(6)
7. **Pollution And Its Control**: Air water pollution by thermal power plant and its control, thermal pollution by thermal and nuclear power plants, radio active pollution, methods suggested to reduce pollution.(6)

Text Books:

1. Power Plant Engg. by S. Domkundwar, Dhanpat Rai & Sons.
2. Power Plant Engg. by R. K. Rajput, Sultan Chand Pub.

BME 420 : Metrology, Quality Control and Reliability (M)

Module – I

Introduction:

1. Need of Inspection ,Sources of errors , Basic types of errors, precision and accuracy . Method of estimating accuracy and precision , standard and their evolutions . (4)
2. **Simple measurement tools** : Rules , Callipers , Height gauges , Micrometers , Depth gauge , Dial indicator , slip gauges , sine bar .(4)

Module - II

3. **Limit, fits and tolerance and Gauge Design** : Basic concepts of limit fits and tolerance , Interchangeability and selective assembly , ISO system of tolerance , Taylor's principle of gauge design, Gauge design –Basic design rules for plug and ring gauges .(6)
4. **Interferrometers** : Types of light sources and interferometers , Types of scale and grading , Optical flats .(4)

Module - III

5. **Screw Thread Measurement** : Standard thread profiles , Effective diameter , Measurement of effective diameter by 2 wires and 3 wires methods . Best wire size . (5)
6. **Surface Roughness** : Source of surface Irregularities in manufacturing . Roughness and waviness RMS and CLA values , Measurement of surface roughness using Taylor Hobson' s Talysurf .(5)

Module - IV

7. **Statistical Quality Control** : Frequency distribution , Process capability , Variables and Attributes . Control charts(X□ &R charts) for variables , Control chart for attributes (p , np and C charts) . OC curve, Single and Double sampling plan .(7)
8. **Reliability** : Definition , Relationship of Reliability with maintainability and availability, Failure data analysis –Bath tub curve , System reliability , Reliability improvement .(5)

Reference Books:

1. Engg . Metrology by R.K. Jain ,Khanna pub.
2. A text book of Metrology by M.Mahajan Dhanpat rai and co pvt Ltd .
3. Statistical Quality Control by M.Mahajan Dhanpat rai and co pvt Ltd .
4. 4. Reliability Engg. By L.S. Srinath East West press

Elective – I(any one)

BME-421: Refrigeration and Air-Conditioning (M)

UNIT –I(Refrigeration):

Module - I

1. **Air Refrigeration Cycles** :Introduction, Units of Refrigeration, Coefficient of performance of a refrigerator, Open air refrigeration cycle, Closed or Dense air Refrigeration cycle. Air Refrigerator Working on Reversed carnot cycle. Air Refrigerator working on Belt Coleman cycle.(5)
2. **Vapour Compression Refrigeration System** :Analyis of Theoretical vapour Compression cycle, Representation of the cycle on P-H, T-S and P-V diagrams, Simple Saturation Cycle, Sub-cooled cycles and Superheated cycle. Effect of suction and discharge pressure on performance. Actual Vapour compression Cycle. (5)

Module - II

3. **Compound Vapour Compression Refrigeration Cycle** : Introduction, Methods of improving C.O.P – Optimum Interstage Pressure for Two-Stages Refrigeration System. Single load systems, Multi load systems with single Compressor, Multiple Evaporator and Compressor systems. Dual Compression systems.(5)
4. **Vapour Absorption Refrigeration Systems** : Introduction, simple vapour Absorption system. Practical Vapour Absorption System. Advantages of Vapour Absorption sytem over vapour compression system. Coefficient of Performance of an Ideal Vapour Absorption Ref. System. Electrolux(Ammonia-Hydrogen) Refrigerator, Lithium Bromide Absorption Refrigeration System. (5)

Module - III

5. **Refrigerants** : Introduction, Desirable properties of an Ideal Refrigerant. Classification of Refrigerants, Designation System of Refrigerants, Properties of Refrigerants, Uses of Important Refrigerants, Secondary Refrigerants – Brine. (6)

UNIT-II (Air Conditioning)

Module - IV

1. Psychrometry and Psychrometric properties, psychrometric Relations, Psychrometric chart, Psychrometric processes. Adiabatic mixing of two air streams. Requirements of Comfort Air-Conditioning :

   Requirements of comfort Air-Conditioning, Thermodynamics of Human Body, The body defence, Effect of heat on work performance, Comfort and Comfort chart, Effective Temperature.

   Air Conditioning Systems: Process in Air-Conditioning, Summer,Winter and Year Round Air-Conditioning, Cooling Load Calculations, Design of Air-Conditioning Systems. (14)

Text Book :

1. A course in Refrigeration and Air-Conditioning By S.C. Arora and S. Domkundwar, Dhanpat Rai Sons.

Reference Books :

1. Refrigeration and Air Conditioning by P.L. Balany, Khanna Pub.
2. A text book of Refrigeration and Air-conditioning by R.S. Khurmi and J.K. Jai, S.Chand & Co.

BME-421: Tribology (M)

Module - I

1. Introduction : Lubricant and lubrication, Types of bearings, properties and testing of lubricants, equations of flow, Hag poiseulle flow, flow between two parallel plates.(6)
2. Hydro dynamic lubrication :Petroffs equation for a lightly loaded bearing mechanism, pressure development in an oil film, Reynold's equation in two dimensions, load carrying capacity of journal bearing, Heat balance of lubricants.(9)

Module – II & III

3. Hydrostatic Bearing:Principles, Component of hydrostatic lubrication, Hydrostatic circular thrust bearing, calculation of required in pressure, load carrying capacity, flow rate, power loss in bearing due to friction, concept of gas lubricated bearing.(12)
4. Design and selection of antifriction bearing (3)

Module - IV

5. Friction and wear of metals :Theories of friction, surface contaminants, Effect of sliding speed on friction, classification and mechanism of water resistant materials. (10)

Text books :

1. Introduction to Triboloty of Bearing, B.C. Majumdar(AHW)
2. Basic Lubrication theory, A. Cameron(John Wiley & Sons)
3. Mechanism and machine Theory, J.S. Rao & R.V. Sukki Patti, New Age Int. Pub.

BME-421: Composite Materials (M)

Module – I

1. **Definition and Classification of Composites**, MMC, PMC, CMC, Reinforcing fibres – Natural fibres(cellulose, jute, coir etc.), boron, carbon, ceramic glass, aramids, polyethelene(UHMWPE), Poly benz-thin-soles etc. (10)

Module – II

2. **Particulate fibres** – Importance of particle shape and size. Matrix resins – thermoplastics and thermosetting matrix resins (10)

Module – III

3. **Coupling agents** – Surface treatment of fillers and fibres, significance of interface in composites, Nano-composites, short and continuous fibre reinforced composites, critical fibre length, anisotropic behaviour, SMC, BMC & DMC etc. (10)

Module – IV

4. **Fabrication techniques:** pultrusion process filament winding, prepreg technology, injection and compression moulding, resin transfer moulding, reaction injection moulding, properties and performance of composites, Application. (10)

Reference Books:

1. Composite materials – Science & Engineering by K.K. Chawla, Springer – Verlag – New York 1987.
2. Composite Materials – Engineering and Science, by F.L. Mathew & R.D. Rawlings, Chapman & Hall London, 1994
3. Tribology of Natural fibre composites by Dr. N.Chand, Wood Head Pub. Ltd. England .

BME-421 : Non Conventional Energy (M)

Module – I

1. **Fundamentals of Energy-Science and Technology** : Classification of energy resources, Consumption trend of primary energy resources, Importance of nonconventional energy resources, World Energy status, Energy scenario in India. (8)
2. **Solar Energy** : Measurement of solar radiation, solar radiation data, solar radiation geometry, solar radiation on inclined plane surface. Solar collector, solar water heater, solar refrigeration and air conditioning system, solar cooker, solar furnace, solar green house, solar cell fundamentals. (7)

Module – II

3. **Wind Energy** : Wind turbine sitting, major applications of wind power, Basic of fluid mechanics, wind turbine aerodynamics, Wind energy storage. (5)
4. **Biomass Energy** : Biomass resources, Biomass conversion technologies, Biomass gasification, Biomass liquification, Biomass to ethanol production, Biogas production from waste biomass.(5)

Module – III

5. **Ocean Energy** : Tidal energy, wave energy, ocean thermal energy (3)
6. **Emerging technology** : Fuel cell, Hydrogen energy. (2)

Module – IV

7. **Miscellaneous Nonconventional Technologies**: Magneto hydrodynamic(MHD) power conversion, Thermo-electric power conversion.(5)
8. **Financial and Economic Evaluation** : Basic terms and definitions, calculation for the case of single payment and for uniform series of payment. (5)

Text Book :

1. Non-conventional Energy Resources, by B.H. Khan, TMH.

Elective – II(any one)

BME 422 : Operation Management (M)

Module – I

1. **Organisation**: definition, system approach, essential elements of good organisation, structure of organisation , line, staff and functional organisation.(5)
2. **Forms Of Business Organisation**: types of ownership, individual, partnership, joint stock, cooperative public sector, private sector. (5)

Module - II

3. **Productivity**: definition, importance, productivity and production, measurement of productivity, productivity index, productivity improvement procedure.(5)
4. **Forecasting**: definition, basic types, objectives, methods of forecasting, advantages and limitations.(5)

Module - III

5. **Facilities Location And Design**: Factors Influencing Plant and Warehouse Location, Impact of Location on Cost And Revenues, Layout Types, Process, Product, Fixed Position, CRAFT, workplace design , working conditions : Noise , Illumination .(4)
6. **Design of Products & Services:** Design Of Products, Services And Products, Life Cycle, Product Development And Design, Product Vs Service Design Of Service, Value Engineering, Value Analysis For Cost.(4)
7. **Capacity Planning**: Plant Capacity, Machine Capacity And Machine Selection, Line Balancing, Break-Even Analysis.(2)

Module - IV

8. **Job Design**: Job Analysis, Job Evaluation & Merit Rating.(3)
9. **Method Study & Work Measurement**: Introduction To Work Study, Basic Procedure / Steps In Method Study, Recording Techniques, Work Measurement: Techniques, Time Study Using Stop Watch, Standard Time.(7)

References Books:

1. Production Systems Analysis & Control by J L Riggs, John Wiley Pub.
2. Production & Operation Management by E E Adam & R J Ebert, Prentice Hall Of India.
3. Production & Operation Management by S N Chary, TMH.
4. Production & Operation Management by R Paneersalvam, Prentice Hall Of India.

Eighth Semester(M) – Theory

BME 423-Internal Combustion Engine & Gas Turbines (M)

Module - I

1. Introduction: Classification of I.C engines, working cycles, comparison of Two stroke &four stroke engines, Comparison between S,I & C.I engines.(2)
2. Fuel combustion &Fuel injection: Structure & composition of I.C engine fuel, Fuel rating Properties of fuel, Fuel additives and non petroleum fuels .Fuel air requirement for ideal normal operation, maximum power & quick acceleration, simple carburetor & it's draw back. Practical carburetor, petrol injection. Requirements & type of diesel injection system, fuel pump, injectors &nozzles.(8)

Module - II

3. Ignition &combustion in I.C Engines: Battery, magneto & Electronic ignition systems, Ignition timing, spark advance mechanism. Stages of S.I engine combustion, Effect of engine variables on ignition lag flame front propagation. Abnormal combustion, preignition & detonation, Theory of detonation, Effect of engine variables on detonation, Control of detonation. Requirement of good combustion chambers for S.I engines. Stages of C.I engine combustion. Effect of engine variables on delay periods. Diesel Knock & methods of control in C.I. engine combustion chambers.(10)

Module - III

4. Testing and performance : Power ,Fuel and air measurement methods, performance of S.I. and C.I. Engines, Characteristics curve .Variables affecting performance and methods to improve engine performance.(5)
5. Cooling and Lubricating Systems, Engine Emission & Controls : Air cooling and Water cooling system ,Effect of cooling on power output & efficiency, properties of lubricants &types of lubricating system engine emission & it's harmful effect. Methods of measuring pollutants and control of engine emission.(7)

Module - IV

6. Gas turbines: Introduction, open & closed cycle gas turbines, Constant volume &constant pressure cycles. Thermodynamic analysis of ideal basic cycle with regeneration reheat & intercooling .Analysis of ideal basic cycle considering actual losses. Application of gas turbine.(8)

Reference Books:

1. A course in I.C. Engines-By –Mathur and Sharma ,Dhanpat Rai & Sons.
2. A Text book of Internal Combustion Engines – R.K. Rajput , Lami Pub.(P) Ltd.
3. Gas Turbines-V.Ganesan, TMH

BME 424: Mechanical Engineering Instrumentation & Control (M)

Module - I

1. **Introduction :** The significance of mechanical measurement ,basic detector transducer elements : Electrical transducer , Sliding contact devices ,Variable-inductance transducer elements ,the differential transformer, variable-reluctance transducer , capacitive transducer , The piezoelectric effect, Photo electric transducers .

   Intermediate modifying system : Electrical intermediate modifying devices , input circuitry , The simple current sensitive circuit , the ballast circuit , the voltage dividing potentiometer circuit , Resistance bridges . Terminating Devices and Methods : Introduction , Meter indicators , CRO, Oscillographs .(12)

Module - II

2. **Strain Measurement :** The electrical resistance strain gauge , The metallic resistance strain gauge , selection and installation factors for metallic strain gauges , circuitry ,metallic strain gauge . The strain gauge ballast circuit ,the strain gauge bridge circuit, Temperature compensation .(5)

3. **Temperature Measurement** : Use of bimetals pressure thermometers , Thermocouples , Pyrometry , Calibration of temperature measuring devices .(3)

Module - III

4. **Measurement of Pressure :** Pressure measurement systems , Pressure measurement transducer, Gravitational transducer ,Electric transducers ,Elastic diaphragms , Secondary transducer used with diaphragms ,strain gauge pressure cells , measurement of high pressure , measurement of low pressures ,dynamic characteristics of pressure system ,calibration methods .(5)
5. **Measurement of Fluid Flow** : Flow characteristic obstruction meters , obstruction meters for compressible fluids , The variable area meter , calibration of flow measurement devices .(3)

Module - IV

6. **Control System**: Description of open and closed loop control system and their block diagrams use of block diagrams , Use of block diagram and signal flow graph to find overall transfer function , 1st and 2nd order systems and their response to step and sinusoidal input , error analysis , static and dynamic error coefficients , Routh's stability criterion, Polar plot, Nyquist plot, gain margin and phase margin . (12)

Text books ;

1. Mechanical Measurements , T.G. Beckwith and M.Lewis Buck , Oxford & IBH Publishing co.
2. A course in Mechanical Measurements and Instrumentation by A.K. Sawhney , Puneet Sawhney
3. Modern control Engineering , K.K. Ogata , Prentice Hall India .

Elective –III(any one)

BME 425: Industrial Management (M)

Module - I

1. **Basic Management Theory**:- Evolution of Management Thought, Scientific Management, Organization as a System, Function Of Management, Principles of Management, Planning, Decision Making, Organizing Principle, Delegation Of Authority, Line and Staff Function, Leadership, Motivation, Communication, Controlling. (8)

Module - II

2. **Personnel Management**:- Organization as Social System, Motivation & Behaviour, Role of Personnel Management, Recruitment, Selection, Training, Performance Appraisal, Job Evaluation and Merit Rating, Wage Policy, Incentives, Group Dynamics, Job Satisfaction and Morale.(8)
3. **Materials Management**:- Purchasing, Selection of Vendor, Learning Curve Concept, MRP.(4)

Module - III

4. **Marketing Management**:- Selling and Marketing Concept, Role of Marketing Management in the Process of Marketing Management, Product Life Cycle, New Product Development Strategy, Market Research, Consumer Behaviour, Sales Promotion Advertising, Pricing Strategy, Break even analysis, Channel of Distribution. (10)

Module - IV

5. **Financial Management**:- Scope, Time Value of Money, Depreciation cost of a product, Financial Statement Analysis, Ratio Analysis, Working Capital, Sources of Finance.(5)
6. **Industrial Relation**:- Trade Union, Industrial Dispute, Workers Participation In Management, Industrial Legislation, Labour Law, Factory Act.(5)

Reference Books :

1. Industrial Engineering & Management Science, by T R Banga, N K Agarwal and S C Sharma, Khanna Pub.
2. Personnel Management by A Mannappa & M S Saiyadain.
3. Fundamentals Of Financial Management by Prasanna Chandra, TMH.
4. Industrial Engineering & Production Management by M Mahajan, Dhanpat Rai Publication.

BME 425 : Entrepreneurship (M)

Module - I

1. **Entrepreneurship :** Concept, Historical background, Economic development and entrepreneurship, role of Entrepreneurship in Industrialization, Entrepreneurship programmes(EDPS) in India, Indian middle class values. (8)

Module - II

2. **Entrepreneurial Qualities :** Achievement motivation, Creativity, perception, Risk taking, Entrepreneurial goal setting, Group activities, Exercise & connected with motivation. (8)
3. Environmental scanning, Business opportunity guidance, Product selection, Market research. (4)

Module - III

4. **Assistance of Govt. agencies** – Role of DIC, SFC, SISI, TCO and banks, Procedure in setting up of an enterprise.(8)

Module - IV

5. Assessment of working capital, preparation of project report, project appraisal elementary knowledge on costing, Book keeping, Balance sheet preparation, Ratio analysis, Income tax, Excise duty.(8)
6. Management of small scale industry-Decision making, Leadership, Communication skill, Stress management.(4)

Reference Books:

1. Entrepreneurship of small industries by M.U.Deshpande – Deep and Deep publication
2. A Hand Book of small scale Industry by ED II Pub., Ahamedabad
3. Management of small scale Industry by Vasant Desai, Himalaya Pub. House.

BME425:Finite Element Method (M,MS)

Module - I

1. Structural stiffness and network analysis, Assembly and analysis of a structure.(4)
2. Finite elements of an elastic continuum, Displacement approach, Minimisation of total potential energy, convergence criteria.(6)

Module - II

3. Generalisation of finite element concepts, Nodeless variables, Alternative approaches to finite element formulations. (6)
4. Plane stress and plane strain, Element characteristics, Some practical applications.(4)

Module - III

5. Axisymmetric stress analysis, Element characteristics, Some illustrative examples. (5)
6. Three dimensional stress analysis : Tetrahedral Element characteristics.(5)

Module - IV

7. Computer methods and computer programmes, Data input, stiffness generations, Assembly and solution of equations and output of results.(10)

Text Book:

1. The Finite Element Method in Engineering Science by Zienkiwics, TMH – Chapters 1,2,3,4,5 & 20

Ref. Book:

1. Introduction to Finite Element Method by Abel and Desai - EWP

Elective – IV(any one)

BME 426: Mechanical Vibration (M)

(Elective – IV)

Module - I

1. **Damped System with Single degree of freedom**: Equilibrium method , Viscous damping : Law of damping , Logarithmic decrement , Steady state solution with viscous damping , Reciprocating and Rotating unbalance , Base excitation Vibration Isolation, Energy dissipated by damping , Equivalent viscous damping . Sharpness of resonance , Vibration measuring instruments , Whirling of rotating shafts, Rigid shaft supported by flexible bearings .(14)

Module - II

2. **Two degree of freedom system** : Generalised derivation of equation of motion , co-ordinate coupling , Langrange's equation . Application of dynamic vibration absorber .(7)

Module - III

3. **Multi-degree of system** : Derivation of equation , Calculation of natural frequencies, Maxwell's reciprocal theorem, Rayleigh ,Stodala ,matrix iteration & Holzer methods.(8)

Module - IV

4. **Torsional Vibration**: Single & multi rotor system , Geared system and Branched system.(6)
5. **Vibration of continuous system** : Euler equation for beam, Transverse vibration of beams with different end conditions(cantilever beam , simple supported beam and fixed beam). (5)

Text Books:

1. Mechanical Vibration -Tse , Morse & Hinkle Prentice Hall of India
2. Mechanical Vibration with application –W.T.Thomas CPC Publication

BME426:Automobile Engineering (M)

(Elective – IV)

Module - I

1. **Introduction:** Main units of automobile , chassis and body , different system of automobiles , descriptions and materials of main parts of the engine , cylinder head , cylinder block, cylinder liner, crank case, piston , piston rings, piston pin, connecting rod, crank shaft, bearing, valve, valve driving mechanism . Impulse and mechanical balancing of engine . (6)
2. **Power Propulsion :** Resistance to motions, rolling resistance , air resistance, gradient resistance , calculation of power required for propulsion, tractive effort and traction, road performance curves. (4)

Module - II

3. **Clutch:** Types of clutch , Material and construction of clutch , Calculation of main dimension of dry friction clutch . Fluid coupling and its characteristic . (4)
4. **Gearbox:** Sliding mesh ,Constant mesh and synchromesh gearboxes . Design of three speed and four speed gear boxes . Epicyclic gear box . Torque convertor and its characteristic , principle of automatic transmission ,Transfer case . (6)

Module - III

5. **Hooke's joint** , Propellor shaft , Differential , Rear axel , Types of rear axel, semifloating ,three quarter floating and full floating types . Different types of rear axel drives , Hotch kiss and torque tube drive (5).
6. **Braking System:** Hydraulic braking system , Braking of Vehicle when applied to rear , front and all four wheels . Theory of internal shoe brake , Servo and power brakes .(5)

Module - IV

7. **Front wheel geometry and steering system:**Camber , Castor ,Kingpin indicator .Toein ,Centre point steering , condition for true rolling , Akerman and Davis steering ,components of steering mechanism,Power steering .(3)
8. **Suspension System :** Introduction , functions and requirement of suspension system, element of suspension system. Springs, Damper, types of suspension system, wheels and tyres. (3)
9. **Electrical and Electronic system of automobile :** Starting system and starting drive , Generating system ,Igniting system and their electrical sysyem . Recent advances in automotive electronic such as multipleying , sensors and actuators engine and drive line controls , information systems , electronic display Relay , Switching and inter connector and Instrumentation . (4)

Text book:

1. Automobile Engg. By R.K. Rajput, S.Chand
2. Automobile Engg. By K.M.Gupta.I, Vol.I & II, Umesh Pub.
3. Automobile Mechanics (through problem) by Dr.N.K. Giri, Khanna Pub.

Ref. Book:

1. The motor vehicle by Newton & Steed, London Liffee Books Ltd.

BME 426 Intellectual Property Rights (IPR) (M)

(Elective – IV)

Module – I

1. **Introduction** , Invention and Creativity, Intellectual Property(IP) , Importance ,Protection of IPR , Basic types of property(i. Movable property , ii. Immovable property and iii. Intellectual property).(4)
2. **IP Patents,** Copyrights and related rights, Trade Marks and rights arising from Trademark registration, Deficitions, Industrial Designs and Integrated circuits, Protection of Geographical Indications at national and International levels, Application Procedures. (9)

Module – II

3. **International convention** relating to Intellectual Property – Establishment of WIPO – Mission and Activities, History, General Agreement on Trade and Tariff(GATT).(9)

Module – III

4. **Indian Position Vs WTO** and Strategies, Indian IPR legislations, commitments to WTO, Patent Ordinance and the Bill, Draft of a national Intellectual Property Policy, Present against unfair competition. (9)

Module – IV

5. **Case Studies on**, Patents(Basumati rice, turmeric , Neem etc), Copyright and related rights, Trade Marks, Industrial design and Integrated circuits, Geographic indications, Protection against unfair competition. (9)

Text Book:

1. Subbaram N.R., Handbook of Indian Patent Law and Practice, S.Viswanathan(Printers and Publishers) Pvt. Ltd., 1998

Seasonal

Seventh Semester

BME 491 : HT and RAC lab. (M)

A.HT lab

1. Determination of thermal conductivity of composite slab.
2. Determination of heat transfer coefficient of natural convection.
3. Determination of surface emissivity.
4. Efficiency and effectiveness of fins.

B.RAC lab

1. Study of Ice plant.
2. Determination of COP of refrigerator tutor.
3. Study of psychrometric process in AC tutor.
4. Study of domestic refrigerator.

BME 492 : M/c Design -II sessional (M)

1. Problems for practice on theories of failure.
2. Problems for practice on fatigue failure.
3. Design of clutches.
4. Design of spur gear.
5. Design of spiral and bevel gear.
6. Design of crank piston and cylinder.
7. Design of connecting rod and shaft.
8. Design of journal bearing.

BME 493 : Seminar (M)

Individual student has to deliver a seminar talk of either on field training or on advanced technical topic.

BME 494 : Minor project (M)

Different small projects on thrust areas to different groups of students.

Eighth Semester

BME 495 : Comprehensive viva voce: (M)

At the end of semester, a viva voce is to be conducted in the presence of a field expert, external and internal examiners from academic..

BME 496 : Major project (M)

Different projects on thrust areas to different groups of students.

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