CURRICULUM

NATIONAL INSTITUTE OF TECHNOLOGY JAMSHEDPUR
JAMSHEDPUR, JHARKHAND – 831014
(An Institution of National Importance under MHRD, Govt. of India, NEW Delhi)
Department of Mechanical Engineering

Course Structure for B.Tech (Hons) Mechanical Engineering for 2016 & 2017 Batches

Semester-I

S.No.	Subject Code	Subject Name	L-T-P	Credits
1	ME101	Engineering Chemistry	3-0-0	3
2	ME102	Engineering Mathematics-I	3-0-0	3
3	ME103	Basic Electrical & Electronics Engineering	3-1-0	4
4	ME104	Mechanics of Materials	3-1-0	4
5	ME105	Engineering Thermodynamics	3-1-0	4
6	ME106	Workshop Technology	0-0-3	2
7	ME107	Engineering Chemistry Laboratory	0-0-3	2
8	ME108	Basic Electrical & Electronics Engineering Lab	0-0-3	2
Total			15-2-12	24

Semester-II

S.No.	Subject Code	Subject Name	L-T-P	Credits
1	ME201	Engineering Physics	3-0-0	3
2	ME202	Engineering Mathematics-II	3-0-0	3
3	ME203	Basic Civil Engineering	3-0-0	3
4	ME204	Engineering Graphics	3-0-0	3
5	ME205	Material Science	3-0-0	3

6	ME206	English for Communication	3-1-0	4
7	ME207	Engineering Physics Laboratory	0-0-3	2
8	ME208	Basic Civil Engineering Lab.	0-0-3	2
9	ME209	Engineering Graphics Lab	0-0-3	2
Total			18-1-9	25

Semester-III

S. No.	Subject Code	Subject Name	L-T-P	Credits
1	ME301	Engineering Economics	3-0-0	3
2	ME302	Engineering Mathematics –III	3-1-0	3
3	ME303	Kinematics of Machinery	3-1-0	4
4	ME304	Fluid Mechanics	3-1-0	3
5	ME305	Mechanics of Solid	3-1-0	4
6	ME306	Mechanics of Solid Laboratory	0-0-3	2
7	ME307	Machine Drawing Laboratory	0-0-3	2
8	ME308	Fluid Mechanics Laboratory	0-0-3	2
Total			15-4-9	24

Semester-IV

S. No.	Subject Code	Subject Name	L-T-P	Credits
1	ME401	Introduction to Soft Skills	2-1-0	3
2	ME402	Steam Power Systems	3-1-0	4
3	ME403	Numerical Methods & Computational Techniques	3-1-0	4
4	ME404	Manufacturing by Shaping & Joining	3-0-0	3
5	ME405	Dynamics of Machinery	3-1-0	4
6	ME406	Numerical Methods & Computational Techniques Lab.	0-0-3	2
7	ME407	Workshop Practice (Casting & Welding)	0-0-3	2
8	ME408	Dynamics of Machinery Laboratory	0-0-3	2
Total			14-4-9	24

Semester-V

S.No.	Subject Code	Subject Name	L-T-P	Credits
1	ME501	Machine Tools & Machining	3-0-0	3
2	ME502	Industrial Management	3-0-0	3
3	ME503	Heat & mass Transfer	3-1-0	4
4	ME504	Design of Machine Elements	3-1-0	4
5	ME505	Vibration & Noise Control	3-1-0	4
6	ME506	Metrology & Machining Laboratory	0-0-3	2
7	ME507	Heat & Mass Transfer Laboratory	0-0-3	2
8	ME508	Design & Drawing Laboratory	0-0-3	2
Total			15-3-9	24

Semester-VI

S.No.	Subject Code	Subject Name	L-T-P	Credits
1	ME601	Fluid Machinery	3-1-0	4
2	ME602	Elective-I	3-0-0	3
3	ME603	Mechanical System Design	3-1-0	4
4	ME604	Internal Combustion Engine & Gas Turbine	3-1-0	4
5	ME605	Refrigeration & Air Conditioning	3-1-0	4
6	ME606	Fluid Machinery Laboratory	0-0-3	2
7	ME607	Mechanical System Design laboratory	0-0-3	2
8	ME608	Applied Thermodynamics Laboratory	0-0-3	2

9	ME609	Comprehensive Viva-Voce		2
Total			15-3-9	27

Semester-VII

S.No.	Subject Code	Subject Name	L-T-P	Credits
1	ME701	Organizational Behavior & Industrial Psychology	3-0-0	3
2	ME702	Computer Aided Design & Manufacturing	3-1-0	4
3	ME703	Renewable Energy System	3-1-0	4
4	ME704	Elective-II	3-0-0	3
5	ME705	CAD/CAM Laboratory	0-0-3	2
6	ME706	Renewable Energy System Laboratory	0-0-3	2
7	ME707	Industrial Training		2
8	ME708	Minor Project	0-0-3	4
Total			12-2-12	24

Semester-VIII

S.No.	Subject Code	Subject Name	L-T-P	Credits
1	ME801	Power Plant Engineering	3-1-0	4
2	ME802	Environmental Engineering & Management	3-0-0	3
3	ME803	Elective-III	3-0-0	3
4	ME804	Elective-IV	3-0-0	3
5	ME805	General Proficiency		3
6	ME806	Major Project	0-0-12	8
Total			12-1-12	24

Total Credits I- VIII semester: 196

ME602 Elective-I

1. Automobile Engineering
2. Operations Research
3. Turbo Machinery
4. Polymer & Composites
5. Foreign Language: French/German/Japanese
6. Non Conventional Manufacturing Process

ME704 Elective-II

1. Total Productive Maintenance & Value Engineering
2. Heat Exchanger Design
3. Finite Element Methods
4. Advanced Thermodynamics
5. Nuclear Power & Safety
6. Mechatronics

ME803 Elective-III

1. Computational Fluid Dynamics
2. Supply Chain Management
3. Machinery Fault Diagnosis & Signal Processing
4. Fuels, Combustion & Pollution
5. Advanced Energy Conversion Systems
6. Material Handling & Storage
7. Nano Technology

ME804 Elective-IV

1. Robotics &its Applications
2. Gas Dynamics & Propulsion
3. Instrumentation & Control
4. Tribology
5. Management Information System
6. Non Destructive Testing Methods
7. Quality Engineering

Semester III

ME301 Engineering Economics

1. Engineering Economy: Equivalence, time value, present value and annual equivalent cost.
2. Replacement analysis, rate of return evaluation of public activities, generation and evaluation of alternatives in engineering situations, projects, replacement.
3. Depreciation, bath-tub curve, value engineering.
4. Accounting: Financial statements, double entry bookkeeping, inventory control.
5. Costing: Cost concept, material, labour and overhead costs, overhead allocations and absorption: Introduction to job costing, process costing, marginal costing, standard costing, relevant costs for decision making, cost control and cost reduction, measurement and determinants of market power, market power and public policy:

ME302 Engineering Mathematics – III

Laplace Transform:

1. Definition of Laplace Transform, linearity property, condition of Laplace Transform; First and second shifting properties, Laplace Transform of derivative of integrals; Unit step functions Dirac delta-function.
2. Differentiation and Integration of transform, convolution theorem, inversion. Periodic functions, Evaluation of integrals by L.T. Solutions of boundary value problems.

Fourier Transform:

3. Fourier Integral, Formula, Fourier Transform, Fourier sine and cosine transforms. Linearity, Scaling, frequency shifting and time shifting properties. Self-reciprocity of FourierTransform. Convolution theorem.
4. Application to boundary value problems.

Z-Transform:

5. Definition of Z-Transform and its Properties, Initial and final value theorem. Convolution theorem, Evaluation of inverse Z-Transform. Difference equation and its application. Brief introduction of Wavelet Transform.

ME303 Kinematics of Machinery

1. Basic Kinematics concept, Links, Kinematic pairs, Kinematic chains, Mechanisms and inversions, Straight line motion mechanisms, Degree of freedom, Grashof's Criterion.
2. Velocity and acceleration in mechanisms, Instantaneous centre of rotation, Aronhold-Kennedy theorem of three centres, Velocity and acceleration diagram, acceleration centres.
3. Belt, chain and rope drive, Transmission of power through friction clutch, Shoe brakes, Band and block brakes.
4. Law of Gearing, Basic terminology, Geometric and kinematics characteristics of involute and cycloidal tooth profiles, Undercutting and interference, Gear trains, simple, compound and epicyclic gear trains.
5. Governors, Watt, Porter, Proell and Hartnel governors, Governor effort and power, Sensitivity and Isochronisms.

ME304 Fluid Mechanics

1. Introduction: Concept of continuum; Fluid properties, Viscosity, surface tension and capillarity, Real and ideal, Newtonian and Non-Newtonian compressible and incompressible fluids. Fluid pressure and its Measurement; manometers and pressure gauges.
   Fluid Kinematics: Lagrangian and Eulerian methods of describing fluid motion. Types of fluid flow velocity and acceleration, equation of continuity, free and force vortex flows.
2. Fluid Dynamics: Forces influencing motion of fluid, Euler's equation of motion, Bernoulli's equation and its applications, Pitot tube, venturimeter, orificemeter. Momentum and moment of momentum equations, kinetic energy and momentum correction factors, introduction to Navier-Stoke's Equation.
3. Orifices & mouth pieces, Notches and Weirs, Laminar flow through circular pipe; Hagen-Poiseuille equation, Laminar flow between parallel plates: Plane Poiseulle flow and Couette flow.
4. Turbulent Flow: Introduction, shear stress in turbulent flow, hydro- dynamically smooth and rough surfaces, velocity distribution in smooth and rough pipes. Flow through Pipes: Reynold's experiment, Darcy- Weisbach equation for fractional head loss, minor losses, hydraulic gradient and total energy lines, pipes in series and in parallel, equivalent pipe.
5. Forces on Immersed Bodies: Drag and lift forces, drag on a sphere, Stoke's law, drag and lift on acrofoil. Dimensional Analysis and Model Testing: Rayleigh's method and Buckingham pi-Theorem method of Dimensional Analysis. Non- dimensional numbers and its significance, Theory of similarly, Model Laws.

ME 305 Mechanics of solids

1. Strain Energy: Strain energy due to direct bending. Castigliano's theorem, application to deflection of simply supported beams and cantilever beams due to shear.
2. Thick cylinders and spheres: Thick cylinders, Radial and hoop stresses. Application of compound stress theories, compound cylinders, thick spherical- shell radial and circumferential stresses. Rotation of rings and discs: Thin disc of uniform thickness, Radial and hoop stresses, Disc with central holes, Disc of uniform strength.
3. Theories of yielding: Different theories of failure, Comparison of theories of failure, yield loci.
4. Unsymmetrical bending: Flexural stresses due to unsymmetrical bending of beams
5. Shear Centre: Shear centre for thin walled open cross flow section, shear flow.

Analysis of strain: Principal strain, Strain Resette, Mohr's circle of strain & strain Rosette.

Fatigue: Fatigueof metal, Bauschinger's experiment, strain method of obtaining fatigue ranges formula connecting stress range, Maximum stress and ultimate strength S-N curve, gerber's formula, Goodman's law

Creep: Creep of metals, Mechanisms of creep; Equicohesive temperature; Creep curve, Creep rate; Prediction of long term properties from short duration test.

Semester –IV

ME 401 Introduction to Soft Skills

Speech skills; Rules of Accent, Intonation, Group Discussions and mock interviews (interactive sessions)

Formal Communication: Curriculum Vitae, Minutes, Report Writing

Presentation Skills

Negotiation Skills

Non- verbal Communication and Body Language

Multicultural Communication

Time management

Decision making Emotional Intelligence

ME402 Stream Power Systems

1. Analysis of stream cycles, optimization of reheat pressure, and degree of regeneration, coupled cycles, and combined cycles, process heat and power.
2. Fuels and their properties, stoichiometric and actual air requirements, flue gas analysis, boiler energy balance, draft system. Different types of furnaces for burning coal, fuel, oil, and gas.
3. Circulation theory, down- comers and risers, economizers and super heaters, air pre- heater, drum and its internals. Different types of boilers, boiler mountings, Feed water treatment, boiler loading and operation.
4. Stream turbines; Convergent and Convergent- divergent nozzles- theory and design. Impules and reaction turbines, losses in stream turbines, stream turbine governing, Steam turbine auxiliary systems, and instrumentation in stream turbine power plants.
5. Theory and design of condensers, air ejectors and cooling tower.

ME 403 Numerical Method & Computational Technique

1. Number Systems and Errors: The Presentation of integers, the representation of fractions, floating- point arithmetic , loss of significance and error propagation; condition and instability computational methods for error propagation; condition and instability computational methods for error estimation, some comments on convergence of sequences
2. The solution of Nonlinear Equations: A survey of iterative methods, programs for some iterative methods, fied-point iteration, convergence acceleration for fixed point iteration, convergence of the Newton and secants methods, polynomial equations: real roots, complex roots and Muller's method.
3. Matrices and System of Linear Equations: the solutions of linear systems by elimination, the pivoting strategy, error and residual of anapproximate solution: norms backward-error analysis and iterative improvement, determinants, the Eigen value problem approximation: uniform approximation by polynomial, data fitting, orthogonal polynomials, list- squares approximation by polynomial, approximation by trigonometric polynomial, fast Fourier transform, piecewise- polynomial approximation.

4. Interpolation , Differentiation and intergration: Polynomial forms , the divided-difference table, interpolation at an increasing of interpolation points, the error of thr interpolating polynomial, interpolation in a function table based on equally spaced points. Numberical quadrature extrapolation to the limit Romberg integration.
5. The Solution of the differential equations: mathematics preliminaries, simple differential equations, numerical integration by Tayler series, error estimates and converenge of Euler"s method Runge- kutta methods, step size control with Runge- Kutta methods, multistep formula, predicator-Corrector methods, stability of numerical method Introduction of Solution of P.D.E. Partial differential Equations and their classifications, finite difference representation of first order and second order derivatives, solution procedure of homogeneous parabolic, elliptic and hyperbolic equations.

ME404 Manufacturing by shaping and joining

1. Casting: Types of foundries, steps in making a casting : cast metals; types, materials and allowances of patterns;
2. Moulding processes and their characteristics ; moulding materials; gating and risering; melting furnaces; casting defects
3. Welding: Welding processes, welding energy sources and their characteristics; fluxes and coatings; weldability and welding of various metals and alloys; metallurgical characteristics of welded joints; weld testing and inspection.
4. Forming: Classification of metal forming processes; basic metal working concepts and plasticity: yield criterion; slip line fields; estimation of force and energy requirements;
5. Technology of bulk and sheet metal forming processes; precision forming processes; various features of different types of metal forming dies; principles of power forming

ME405 Dynamics of Machinery

1. Kinematics analysis of planar mechanism: mobility analysis and range of movements. Dimensional synthesis of planar mechanism, three positions synthesis for function generation, path generation and rigid body guidance, dead centre problem, branch and order defects.

2. Dynamics of plane motion of rigid bodies, dynamically equivalent mass system, forces in mechanism and machine, friction in link mechanism.

3. Displacement and velocity and acceleration of piston in a slider-crank mechanism, flywheels.

4. Balancing of inertia forces of revolving and reciprocating masses, Synthesis of Cams.

5. Free and force vibration analysis of single and two degrees of freedom systems.

Semester V

ME501 Machine Tools and Machining

1. Purpose, principles and definition of machine tools, concept of generatrix and directrix. Major classification of conventional machine tools and their specifications, kinematics systems of common

machining tools; centre lathe,

2. Milling machines, drilling machines, shaping, planning and slotting machines, semi-automatics lathes; capstan and turret lathe, single spindle automatic lathe. Hydraulic drive in machine tools. Basic principles of CNC machine tools.

3. Tool geometry, mechanism of chip formation, mechanics of machining; estimation and measurement of cutting forces and power consumption. Effects of high cutting temperature, role various geometrical and process parameters on cutting temperature. Control of cutting temperature and cutting fluid application.

4. Failure of cutting tools, mechanisms, geometry and measurement of cutting tool wear. Tool life; definition, assessment and improvement of cutting tool materials. Mechanics of grinding. Economics of machining.

5. Assessment of quality of machined products, measurement of dimensions; length, depth, outside and internal diameter, taper screw thread and gears, measurement of inclination, flatness and roughness of surfaces. Gauging.

ME502 Industrial Management.

1. Inventory management and function model (deterministic) and price break up, Work study, Motion study, Flow process Chart. Motion economy therblige.

2. Man machine chart, time study, work measurement technique, performance rating, standard time, work sampling, ergonomics,

3. sampling inspection, acceptance sampling plans, control charts of variables, operating characteristics curves.

4. transportation and assignments models, linear programming, simplex method, queuing model (single channel)

5. CPM, PERT, cost crashing of network, new management concept, TQM, JIT, TPM, six sigma, maintenance management.

ME503 Heat and Mass Transfer

1. Introduction: basic concepts and models, Relationship to thermodynamics. Conduction mechanism: Fourier's generation conduction equation in 3-D, 1-D study state conduction with heat generation, Composite plane wall and cylinders, Thermal resistance network, Critical Thickness of Insulations, Extended surface heat transfer

2. 2-D steady state conduction: Solutions for simple boundary conditions, Un-steady heat conduction: Lumped parameters systems, semi-infinite wall with convection boundary conditions, use of heisler chart.

3. Convection: Review of hydrodynamics equations of boundary layer theory, velocity and thermal boundary layers, laminar boundary layer analysis on flat plates. Fully developed heat transfer though a smooth pipes, relation between fluid friction and heat transfer, turbulent boundary layers, forced convection correlations.

4. Free convection: Laminar free convection on a vertical flat plate, empirical co-relations. Boiling and condensation: Mechanism, Laminar film condensation on a vertical plate. Heat Exchangers: Types analysis, LMTD, effectiveness-NTUmethod.

5. Radiation: Physical mechanism, radiation properties, black body radiation, grey body, spectra dependence of radiation properties, Kirchoff's Law, Wien's displacement law, View factor, radiation exchange between infinite planes, and between grey bodies, radiation shields, reradiating surface and 3- surface encloses, network representations. Fick's law of diffusion coefficient, analogy between heat and mass transfer.

ME504 Design of Machine Element

1. Introduction : Engineering materials and their properties, manufacturing considerations in machine design.

2. Simple stresses in machine parts, Torsional and bending stresses, Dynamic loads.

3. Design of pressure vessels and pipe joints. Design of keys, couplings, shafts, levers, columns, studs,and power screw.

4. Design of Belt drives, pulleys, springs, clutches and breaks.

ME505 Vibration and Noise Control

1. Introduction to single DOF, 2-DOF and multi degree of freedom systems.

2. Free and forced response, Torsional vibration.

3. Vibrations of continuous systems; string, bars, beams and plates.

4. Force transmissibility, design of vibration isolators and absorbers,

5. Solution of 1- and 3-D wave equations, sound field characterization, principle of noise control, basics of acoustics, sound control materials: absorbers, barriers and damping materials, silencers, introduction to active noise and vibration control.

Semester VI

ME601 Fluid Machinery

1. Introduction: Classification of Fluid Machineries. Dynamic Action of Fluid Jet: Impact of fluid-jet, Impact of fluid jet on fixed and moving flat plates, impact of jet on fixed and moving curved vanes, flow over radial vanes. Euler's fundamental equation, Hydraulic Turbines: Introduction, classification, Impulse Turbine: constructional details, velocity triangles, power and efficiency calculations. Governing ofTurbines.
2. Reaction Turbines: constructional details, working principle, velocity triangles, power and efficiency calculations, degree of reaction, Draft tube, cavitations, performance characteristic curves. Unit and specific quantities, Models relationship, selection of hydraulic turbines.
3. Positive Displacement Pumps: Reciprocating Pump: Construction and working principle, Slip,

Indicator diagram, Accelerating and frictional heads, theory of air vessel, gear oil pump Fluid Systems -constructional details, principle of operation and usages of Hydraulic ram, Hydraulic Accumulator, Fluid coupling and Torque converter.

4. Roto-dynamic Pumps: Introduction, classification, centrifugal pump: main components, working principle, velocity triangles, effect of shape of blade, specific speed, heads, power and efficiency calculations, minimum starting speed, multistage pumps, performance characteristics, comparison with reciprocating pump.
5. Air Compressor: Introduction to fans, Blower and Compressor Reciprocating compressor: Introduction, P-V diagram, calculation of isothermal and adiabatic work and efficiency, volumetric efficiency. Effect of clearance, multistage compression, intercooling. Centrifugal compressor: Construction and working static and total heads velocity triangles, slip factor, losses and efficiencies, performance characteristics.

ME 603 Mechanical System Design

1. Design of Flywheel and hydraulic press,
2. Bearing: types and selection, Design of journal, ball, and roller bearings, bearing life, lubrication, sealing and mountings. Hydrodynamic theory of lubrication. Design of bearings using design charts,
3. Design of gears, gear boxes, chain drives.
4. Design of I. C. Engine parts: Cylinder, trunk piston, connecting rod, crank shaft.
5. and valve gears, Design of centrifugal pump.

ME604 Internal Combustion & Gas Turbine

1. Introduction, classification, two stroke four stroke (SI and CI) engines, engine parts, engine working principle and valve timing diagram
2. Engine performance test: purpose and types, measurement of power, Engine system & performance parameters evaluation, theory of combustion, principle of combustion, S.I & C.I. Engine combustion process & parameter & their dependence on engine variables and operating parameters.
3. Combustion: adiabatic flame temperature, combustion processes &combustion chambers for SI and CI engines, pollutant formation and control, effect of engine variables on combustion processes, knocking in SI & CI engines, petroleum based fuels, gasoline & diesel fuel and theirs properties, blending, knock rating of engine fuels, Pollutant Formation & Control
4. Carburation: working principles, chemically correct air-fuel ratio and load variation, Carburettors & modern air fuel systems, compensating devices, venturi and jet dimension calculation, injection system, super charging, engine lubrication and cooling.
5. Principle, simple, open gas turbine cycle, effect of operating variables on thermal efficiency, regenerative and reheat cycles, gas turbine applications, closed cycle gas turbine, Combined cycle, Gas turbine Based-hybrid cycles

ME605 Refrigeration and Air conditioning

1. Brief history of refrigeration, refrigerants and environmental issues, reverse Carnot cycle, actual and theoretical cycle
2. Compressor volumetric efficiency, effect of suction and discharge pressure, sub-cooling and super heating on compressor performance, compound compression with inter cooling, cascading.
3. Refrigerants: their suitability, charging and leak detection, Ammonia and Li-Br, vapour-absorption systems, air cycle refrigeration, air craft cooling, cryogenics systems, Linde and Claude cycles-applications,
4. Psychometric processes, Evaporative coolers, cooling towers, coils, Chemical dehumidification, elements of human comfort air conditioning.

Elective-I ME602

(i) Automobile Engineering

1. Description of Power unit: Fuel supply system and engine lubrication, Transmission requirements.
2. Fluid and automatic transmission system along with their performance requirements, tractive resistance. Different types of steering systems and performance requirements, Stability of vehicles on level road and curve path.

3. General braking requirements, weight transfer during braking, different type of brakes,general considerations of strength andstiffness of vehicle frame.
4. Various suspension system,shock absorbers and engine mountages, Tyre –pavement interactionforces,tyre wear & SAE terminology various types of types of ignition systemswithwiringdiagram.
5. Testing of vehicles and handling characteristics, Preventive maintenance, troubleshooting& tuning of power unit, pollution due to vehicles emission, Effect of design and operating condition on pollution.

(ii) Operation Research

1. Scope and application of operation research ;
2. Linear programming, graphical and simplex method transportation and assignment models. Simulation andMonte-Carlo techniques.
3. Queuing theory (single and double channel) CPM and PERT and CPM- crashing networks.
4. Dynamic programming, Sequencing model (n jobs-2machines n- jobs- 3 machines), Replacement problems and Reliabilitytheory.
5. Inventory models with probabilistic demands and area, quantity constraints, Game theory (competitive strategies), Non-linear programming (Kuhn-Tucker condition).

(iii) Turbo machinery

Axial flow compressor: Flow through cascades, terminology, flow separation, radial equilibrium theory, actuator disc theory, effect of tip clearance, secondary flow performance characteristics, surging and installing. Axial flow turbine: vortex theory, blade design, cooling of turbine blades, performance characteristics, tipclearance

losses, profile losses, secondary flow loss, annulus loss, limiting factor in turbine design.

(iv) Polymers and Composites

Introduction : polymeric materials, Engineering plastics, Polymer alloys, Selection of plastics, Mechanical properties, Degradation , Wear resistance, Frictional Properties, Special Properties Structural features. Expanded plastics, Plastics as packaging material.Theoretical aspects; visco- elastic behaviour, Mathematical models for visco-elastic behaviour, Deformation behaviour of plastics, Reinforced plastics.

Analysis of polymer melts flow: Newtonian and Non Newtonian fluid flow, Flow in circular section, Flow in rectangular section etc. Overview and analysis of various plastics forming operations; Extrusion, Injectionmoulding, Thermo forming, Calendar ing, Compression moulding . Blow moulding, Transfer moulding, Processing of reinforced plastics. Die design for simple components.

Classification and characterization of composite materials; Fibrous, Laminated and particulate and composites: laminate and laminates: manufacturer of laminated fibre-reinforced composites Materials. Macro mechanical behaviour of laminar stress-strain relations, engineering constraints for orthopic materials. Stress-strain relations for laminar of arbitrary orientation, strengths and stiffness of orthotropic lamina: Bi-axial strength theories. **Micromechanical behaviour of laminate: Rule** of mixtures. Macro mechanical behaviour of laminates ; Rule of mixtures.

Macromechanicalbehaviour of laminates: Single layered configurations. Symmetric. Laminates, Anti-symmetric laminates , know symmetric: Strength of laminates: Interlaminar stresses: Design of Laminates. Buckling and vibration of laminated beams, plates and shells.

Semester VII

ME701 Organizational Behaviour and Industrial Psychology

Personality self awareness; perception and attribution, learning, values and attitudes, Motivation; Groups, Group Dynamics, Teams; Skills for Managing Teams-Communication conflict, Power and Influence; Leadership, What is an organization; Determinants and Parameters of Organizational Design; Organization and Environment Organizational Strategy; Power and conflicts in organization; Organization and decision making and Strategy formulation; Organizational culture; Organizational failure and Pathology; Organizational change and Development, Organizational Learning and Transformation.

ME702 Computer Aided Design & Manufacturing

Introduction- Concept of CAD/CAM, computer system, Hardware in computer Aided Design System. Product Cycle, computer aided design system, transformation, geometrical modeling, draft Applications, CAD/CAM techniques to finite element data preparation, concept of data structures, Automation, part programming.

ME703 Renewable Energy Systems

1. Energy demand and availability, energy resources, basic concepts of heat and fluid flow for energy systems, Solar energy systems, Solar radiation data.
2. Solar energy collection, Storage and Utilization, Water and air heating, Power generation, Refrigeration and Air-conditioning, Economics,
3. Micro and small Hydro Energy Systems, Systems and Economics, Special engines for low heads, Tidal power.
4. Bio-mass Energy Systems: Various bio-mass sources and waste, Bio-conversion technologies, Bio-gas, Power generation, I.C. Engines modifications, systems economics.
5. Wind Energy, wind data, wind mills, performance and economics, Integrated Energy systems, Systems Design and economics.

Elective-II ME704

(i) Total Productive Maintenance and Value Engineering

TPM: Introduction to TPM, Productivity, major losses, measurement of overall performance, Pillars of TPM, autonomous maintenance, continuous improvements (kaizen), maintenance Prevention, safety and hygiene, preventative maintenance, predictive maintenance and time based maintenance.

Value Engineering: Definition and concept of VE, type of value, cost v/s quality, FAST diagram phases of VE, general phase, information phase, function phase, creation phase, evaluation phase, application and benefits of VE.

(ii) Heat Exchanger Design

1. Heat exchangers: types and construction, heat and fluid flow fundamentals.
2. General design consideration and approaches, computer aided design, cost estimation, optimum design.
3. Design of single phase, liquid to liquid, liquid to gas and gas to gas heat exchangers, design of steam generators and condensers.
4. Design of heat exchangers for liquid metals and molten salts.
5. Radiative heat exchangers, cooling tower

(iii) Finite Element Method

1. Introduction to Finite Element Methods, general descriptions, concept of finite elements: discretization and interpolation function, steps of finite element analysis's procedure.
2. Calculus of Variation: Function and functionals, Euler Lagrange equation, Boundary conditions, determination of functionals for plane and axisymmetric elastic problems, heat conduction problems, plates and shells problems.
3. Finite elements: One, two and three dimepsional elements, axi-symmetric elements: generalised: local, global and natural co-ordinate systems.
4. Iso-parametric, interpolation function, field variable model for displacement and temperature. Direct, variational and Galerikan Methods.
5. Equation of single elements and assembly of elements and solutions. Application to plane and axi- symmetric elastic problems, heat conduction, plates and shells problems.

(iv) Advanced Thermodynamics

Review of basic thermodynamics: laws of thermodynamics, entropy, and entropy balance for closed and open systems. Exergy: Concept of reversible work & irreversibility, second law efficiency, exergy change of a system: closed and open system, exergy transfer by heat, work and mass, exergy destruction, exergy balance in closed and open system; Exergy and analysis of industrial system- power system and refrigeration system. Cycle analysis and optimization; Regenerative reheat Rankine cycle and Brayton cycle, combined cycle power plants, multi-stage refrigeration system. Thermodynamic optimization of irreversible system: system Finite time thermodynamics principles, optimization studies of various thermal systems, Minimization of entropy generation principle. Properties of Gas Mixtures; Equation of state and properties of ideal gas mixtures; Change in entropy on mixing; Partial model properties for non-ideal gas mixtures; Equations of state, Thermodynamics of reactive systems: Conditions of equilibrium of a multicomponent system; Second law applied to a reactive system; condition for reaction equilibrium.

(v) Nuclear Power Safety

1. Basic concept of reactor physics, radioactivity, neutron scattering, thermal and fast reactors
2. Nuclear cross-section, Neutron flux and reaction rates, moderator criteria, reactor core design.

3. Conversion and breeding, types of reactors, characteristics of boiling water, pressurized water, pressurized heavy water, gas cooled and liquid metal cooled reactors.
4. Future trends in reactor design and operation, thermal – hydraulics of reactors, heavy water management, containment system of nuclear reactors.
5. Reactor safety, radiation shields, waste management, Indian Nuclear Power programme.

SEMESTER VIII

ME801 Power plant Engineering

Power Plant types and Economics: History of steam engine, turbines, turbo-machines, pumps, compressor, thermal power plant, overview of hydel power plant, gas turbine power plant, wind power plant, solar power plant, fuel cell power plant etc. Load duration curve, power plant economics, construction cost, fixed cost, interest rates, depreciation rates, fuel cost, present worth, plant net heat rate, load factor etc.

Rankine and binary-vapour cycles: Simple rankine cycle, regenerative- feed heating, re-heating, reheating-regenerative, water-extraction cycle, back pressure, pass-out and mixed pressure turbine cycles.

Fuels, Combustion equipments, Fuel handling systems: Types of fuel, solid, liquid, gas, Examples Coal, fuel oil, natural, cold-derived fuel, synthetic fuel, biomass, combustion reaction, air fuel ratio, heating, value of cold, optimum excess air in boiler, mass balance of furnace, balance draught, draught combustion, equipment of coal, coal crushers, pulverizers, coal handling systems, burners, fluidized bed burners, coal gasifier, combined gas fuel oil burners.

Steam generator, Ash handling systems, Feed water treatment: Types of steam generators, fire tube, water tube, natural circulation, force circulation, critical pressure boiler, electrostatic precipitator, De-mineralization of feed water, steam turbine auxiliary systems: Steam stop valve, tripping devices, oil pullers, filters, ceiling glands etc.

Gas turbine, combined cycle, co-generation and mixed cycle power plant: Gas turbine cycle, inter-cooled gas turbine, reheated gas turbine, recuperated gas turbine, gas turbine based combined cycles, thermodynamics of cycle, performance curves, coal, waste, combined cycles.

Nuclear power plant : Fundamentals of fission reaction, working principle of nuclear reactor, Pressurized water reactor, Boiling water reactor, gas cooled reactor, high temperature gas cooled reactor, Heavy water reactor, Liquid metal fast breeder reactor, Fusion reactor power plant.

Hydro-electric power plant reactor: Advantages–disadvantages, site selection, hydrology, hydrographs, hydroelectric plant layout, catchment area, types of dams, trash rack, tunnel , penstock, hydro-electric plants: High, medium and low head plant, pump –storage hydelplant, mini-and micro- hydel plant, Pelton, Francis and Kaplan turbines.

Governing of HydeIturbines, performance, characteristics curves and selection criterion.

Energy Storage: Thermal, Electro-chemical, Mechanical, hydro, compressed air, adiabatic, hybrid air energy systems, pressurized water sensible energy storage, variable pressure accumulator, expansions accumulator, hydrogen energy storage.

Electrical Equipment on Power Plants: Layout of Electrical equipment, bus-bar, generator, stator, rotor, excitor, switchgears, transformers, circuit breakers, relays, transmission.

Power plant Instrumentation and Air Pollution: Dissolvedoxygen, water purity, thermal conductivity, stack gas measurement, Green house effect, acid precipitation, de-sulphurisation, NO reduction and removal, Nuclear Pollution.

ME802 Environment Engineering &Management

Man, environment and ecosystems, their inter relationships. Types of environment pollutants, their sources and effects. Indoor pollution, air pollution, sources, quantities effects and controls technologies. Noise pollution industrial wastes and their treatment, solid wastes, generation, collection, processing and disposal.Environmental impact and auditing.Introduction to Environmental laws and policies. Global issues on environment

ME803 Elective-Ill

(i) Computational fluid Dynamics

1. A brief overview of the basic conservation equations for fluid flow and heat transfer, classification of partial differential equations and pertinent physical behavior, parabolic, elliptic and hyperbolic equations, role of characteristic.
2. Common method of discretisation; an overview of finite difference, finite element and finite volume methods. Numerical solution of parabolic partial differential equations using finite difference and finite volume methods: explicit and implicit scheme, consistency, stability and convergence.
3. The finite volume method of discretisation for diffusion problems; one dimensional steady diffusion problems, specification of interface diffusivity, source- term linearization. Discretisation of transient one-dimensional diffusion problem. Discretisation for multi dimensional diffusion problems.
4. Solution of descritised equations using point and line iteration, strongly implicit methods, convection diffusion problems, Central difference, upwind, exponential, hybrid and power law schemes, concept of false diffusion ,QUICK scheme.
5. Numerical solution of the Navier–stokes system for incompressible flows; stream function vorticity and artificial compressibility methods. Requirement of staggered grid.MAC, SIMPLEC and SIMPLER Algorithm.

(ii) Supply Chain Management

1. Introduction and overview of supply chain management, Inbound and outbound logistics, Supply chain as a source of competitive advantage. Inbound logistics.
2. Buyer-Vendor co-ordination, Procurement, Vendor development, reduced sourcing and supplier partnership - benefits, risks and critical success factors, multi-level supply control.
3. Outbound logistics: Customer service, physical distribution planning, channel considerations, inventory strategies and management, transportation infrastructure and management, facility location, Materials handling.
4. Strategic considerations for supply chain: Porter's industry analysis and value-chain models, the concept of total cost of ownership, supply stream strategies, classification and development guidelines, measuring effectiveness of supply management, logistics engineering.
5. Operations Research Models for operational and strategic issues in supply chain management. The Bullwhip Effect and supply-chain management game

(iii) Machinery Fault Diagnostics and Signal Processing

1. Purpose and principles of inspection; Procedural steps for condition monitoring Failures and failure analysis. Fault detection sensors.
2. Data processing and signal analysis. Condition based maintenance principles, Economic.
3. On-line-techniques of Vibration and Noise monitoring etc. Offline techniques - NOT, wear debris analysis, Ferrography etc.

4. Common types of sensors and their characteristics and applications; Data acquisition system and process Feature extraction. etc.
5. Reliability/failure concepts. Application of diagnostic maintenance to specific industrial machinery and plants.

(iv) Fuels, Combustion and Pollution

Introduction, fuels gaseous, liquid and solid, sources method of procurements, transportation and end uses. National and International perspective-economics and social aspects, and social policies Physical and chemical characterization.Chemical and thermodynamics and kinetics. Conservation equations for multi component system Pre-mixed system detonation and deflagration, laminar flame problems and effects of different variables. Measurement of flame Velocity Flammability limits, Ignition and quenching, Turbulent premixed flames, Non-premixed systems; laminar diffusion flame jet, droplet bumming. Combustion and solids drying,devolatilization and char combustion coal combustion, pollution; Main pollutants and their environmental impact.NOx,CO, CO and Sox formation chemistry.Particulatepollutants. Emissions from engines, power plants and industrial applications, Low NOx burner and furnace design.

(v) Advanced Energy Conversion Systems

Introduction:Review of Fundamentals of Thermodynamics,Zeorth Law Gas Law, Irreversibility,availability, Second law analysis of power plant cycles.

Introduction to conventional and advanced energy conversion technologies,vapour and gas cycle such as steam power plant,gas turbine,internal combustion engines, combined cycle power plants and stirling engines .storage technologies direct energy conversion system,fuel cell. Natural gas,coal,nuclear power plants.

Gas Turbine based system:Analysis of Inter-cooled,reheated,recuperated Gas Turbine cycles,micro-gas turbines for distributed generation,gas turbine-fuel cell hybrid cycles,gas turbine based combined cycles,natural gas and hydrogen fired gas turbine cycles,humidified gas turbine,steam-injection gas turbines,integrated-coal-gasification-combined cycle(IGCC).

Fuel-cells:Types of fuel cells,Proton-exchange fuel Cell,Solid-oxide-fuel cell,Molten carbonate Fuel Cell,Applications.

Direct Energy conversion systems:MHD,Thermionic methods,Thermo-electric.

Nuclear energy: Nuclear reactor principles,Fission energy,Fusion Energy,Advanced Nuclear power reactors,space-based powerplants.

ME804 Elective-1V

(i) Robotics and Robot Applications

History of development of industrial robots,Fields of application and future scope,Anatomy and structural design of robot, manipulation,arm geometry,drives and control (Hardware) for motions.End Effectors and grippers pickups etc.Matching robots to the working place and conditions, interlock and sequence control,reliability maintenance and safety of robots system,application studies in manufacturing processes,e.g.Casting, Welding,machine tools,machining,heat treatment and nuclear power stations,etc.Synthesis and evolution of geometrical configurations,robot economics,educating,programming and control of robots.

(ii) Gas Dynamics and Propulsion

Revision of fundamentals,thermodynamics of compressible flow –wave motion in compressible medium, Mach number and cone, properties.Steady one dimensional compressible flow through variable area ducts.Converging and diverging nozzles and diffusers.Effect of heating and friction in duct flow,Rayleigh and Fanno lines.Flow with normal shocks.Oblique shocks and reflection expansion waves.Prandt-Meeyer flow.Flow over body.Measurement and application.Jet propulsion-types of engines,propulsion fundamentals,Compressors,Combustor and turbines construction and performance.Rocket propulsion-basics,solid and liquid propelled engine.Parametric studies.Construction features.Single and multi-stage rockets.Trust chamber and nozzle models.Studies of in-use engine.Environmental aspects.

(iii) Tribology

Definition of Tribology,Economic aspects of Tribology(lubrication,friction and wear).Basic equations of the theory of lubrication,its solution for idealized and finite bearings.Calculations of the flow rate.Thermal equilibrium.Bearing design.Design and selection of anti-friction bearings.Theory of friction.Wear and their measurement

(iv) Management Information System

Management and system:Advance in Management.The process of MIS Development:MIAS Organization,Information Dynamics.

Planning:Design and implementation of MIS:IS strategic Planning MIS Design-Group Design Concepts:Acquiring information system

System life cycle: Information Flow:Entity Relationship Modeling: Data Modeling Detailed process Analysis, Data Flow Diagrams.

Decision making system with MIS:System Concept for MIS; Data:Information and Communication;

Problem solving and decision making; IS Security. Control System and Failure, Future Trends in MIS