S Y L L A B U S

BACHELOR OF TECHNOLOGY

MECHANICAL ENGINEERING
(Semester Scheme)

Four Year Degree Course

B. Tech., Second Year Examination	2016
B. Tech., Third Year Examination	2017
B. Tech., Fourth Year Examination	2018

JODHPUR NATIONAL UNIVERSITY

JODHPUR

Jodhpur National University, Jodhpur

Teaching & Examination Scheme

B. Tech II Year (Mechanical Engineering)

III Semester

Theory

S. No.	Code No.	Subject	L	T	MM	Ex. Hrs.
1.	BME 301	Advanced Engineering Mathematics	**3**	**1**	**100**	**03**
2.	BME 302	Engineering Thermodynamics-I	**4**	**1**	**100**	**03**
3.	BME 303	Materials Technology	**3**	**0**	**100**	**03**
4.	BME 304	Kinematics of Machines	**3**	**1**	**100**	**03**
5.	BME 305	Object Oriented Programming In C++	**3**	**0**	**100**	**03**
6.	BME 306	Mechanics of Solids	**3**	**1**	**100**	**03**
7.	GE307 A*	Special Mathematics I**	**3**	**1**	**100**	**03**
		Total	**22**	**5**	**600**	

PRACTICALS & SESSIONALS

S. No.	Code No.	Subject	P	MM
1.	BME 307	Machine Drawing	3	100
2.	BME 308	Kinematics of Machines Lab	2	100
3.	BME 309	Computer Programming lab	2	100
4.	BME 310	Mechanics of Solids Lab	2	100
		TOTAL	**09**	**400**

Total Load: 36

IV Semester

Theory

S. No.	Code No.	Subject	L	T	MM	Ex. Hrs.
1.	BME 401	Fluid Mechanics	3	1	100	03
2.	BME 402	Engineering Thermodynamics-II	4	1	100	03
3.	BME 403	Manufacturing Science-I	3	0	100	03
4.	BME 404	Dynamics of Machine	3	1	100	03
5.	BME 405	Instrumentation & Control	3	0	100	03
6.	BME 406	Advance Mechanics of Solids	3	1	100	03
7.	GE407 A*	Special Mathematics II**	3	1	100	03
		TOTAL	**22**	**05**	**600**	

PRACTICALS & SESSIONALS

S. No.	Code No.	Subject	P	MM
1.	BME 407	Fluid Mechanics Lab	2	80
2.	BME 408	Thermal Engineering Lab-I	2	80
3.	BME 409	Dynamics of Machines Lab	2	80
4.	BME 410	Manufacturing Science Lab-I	3	80
5.	BME 411	Instrumentation & Control Lab	2	80
		TOTAL	**11**	**400**

Total Load: 38

** Sessional Exam: marks shall not be counted for awarding division.

Jodhpur National University, Jodhpur

Teaching & Examination Scheme
B. Tech III Year (Mechanical Engineering)

V Semester

Theory

S. No.	Code No.	Subject	L	T	MM	Ex. Hrs.
1.	BME 501	Fluid Machines	3	1	100	03
2.	BME 502	I.C. Engines	4	0	100	03
3.	BME 503	Manufacturing Science-II	3	0	100	03
4.	BME 504	Industrial Engineering-I	3	0	100	03
5.	BME 505	Machine Design-I	3	0	100	03
6.	BME 506	Steam Turbine & Gas Dynamics	4	1	100	03
		TOTAL	20	02	600	

PRACTICALS & SESSIONALS

S. No.	Code No.	Subject	P	MM
1.	BME 507	Fluid Machines lab	2	80
2.	BME 508	Thermal Engineering lab-II	2	80
3.	BME 509	Machine Design-I Lab	2	80
4.	BME 510	Manufacturing Science –Lab-II	3	80
5.	BME 511	Computer Graphics Lab	3	80
		TOTAL	12	400

Total Load: 34

VI Semester

Theory

S. No.	Code No.	Subject	L	T	MM	Ex. Hrs.
1.	BME 601	Heat & Mass Transfer	3	1	100	03
2.	BME 602	Automobile Engineering	3	0	100	03
3.	BME 603	Manufacturing Science-III	3	0	100	03
4.	BME 604	Industrial Engineering -II	3	0	100	03
5.	BME 605	Machine Design-II	3	0	100	04
6.	BME 606	Gas Turbine & Jet Propulsion	4	1	100	03
		TOTAL	19	02	600	

PRACTICALS & SESSIONALS

S. No.	Code No.	Subject	P	MM
1.	BME 607	Heat & Mass Transfer Lab	3	100
2.	BME 608	Automobile Engineering Lab	2	100
3.	BME 609	Machine Design Lab-II	2	100
4.	BME 610	Manufacturing Sc. & Ind. Engg. Lab	3	100
		TOTAL	10	400

Total Load: 31

Jodhpur National University, Jodhpur

Teaching & Examination Scheme

B. Tech IV Year (Mechanical Engineering)

VII Semester

Theory

S. No.	Code No.	Subject	L	T	MM	Ex. Hrs.
1.	BME 701	Computer Aided Design	3	0	100	03
2.	BME 702	Mech. Vibrations. & Noise Engg.	3	1	100	03
3.	BME 703	Non Conventional Energy Sources	3	0	100	03
4.	BME 704	Operation Research	3	0	100	03
5.	BME 705	Refrigeration & Air Conditioning	4	1	100	03
6.	BME 706	Electives – I (Any one of the following)	3	0	100	03
	BME 706.1	Environmental Science				
	BME 706.2	Optimization Methods				
	BME 706.3	Entrepreneurship Development				
	BME 706.4	Welding Engineering				
	BME 706.5	Plasticity and Metal Working				
	BME 706.6	Financial Management				
		TOTAL	**19**	**02**	**600**	

PRACTICALS & SESSIONALS

S. No.	Code No.	Subject	P	MM
7.	BME 707	CAD Lab	3	100
8.	BME 708	Mech. Vibrations. & Noise Engg.-Lab	2	100
9.	BME 709	Thermal Engg. Lab-III	3	100
10.	BME 710	Practical Training	2	100
		TOTAL	**10**	**400**

Total Load: 31

VIII Semester

Theory

S. No.	Code No.	Subject	L	T	MM	Ex. Hrs.
1.	BME 801	Computer Aided Manufacturing	4	0	100	03
2.	BME 802	Power Plant Engineering	4	0	100	03
3.	BME 803	Operation Management	4	0	100	03
4.	BME 804	Electives –II (Any one of the following)	4	0	100	03
	BME 804.1	Facilities Planning and Material Handling				
	BME 804.2	Design for Fatigue and Fracture				
	BME 804.3	Machine Tool Design				
	BME 804.4	Finite Element Analysis				
	BME 804.5	Mechatronics				
	BME 804.6	Engineering Ethics & Leadership				
		TOTAL	**16**	**0**	**400**	

PRACTICALS & SESSIONALS

S. No.	Code No.	Subject	P	MM
5.	BME 806	Computer Aided Manufacturing Lab	3	125
6.	BME 807	Design Engineering-Lab	3	125
7.	BME 808	Seminar	2	100
8.	BME 809	Project	2	250
		TOTAL	**10**	**600**

Total Load: 26

Jodhpur National University

II B. TECH. III Semester

BME 301 ADVANCED ENGINEERING MATHEMATICS

Teaching Hrs.   Exam Hrs. – 3
L-3 T-1 P-0   Marks: Theory Exam.-80 Term Test – 20 Total 100
Unit

I. **Laplace Transform**: Elementary Formulae, Simple Properties and Theorems, Convolution Theorem,Inverse Laplace Transform, Applications to the Solutions of Ordinary and Partial Differential Equationshaving Constant Co-efficient with Special Reference to Wave and Diffusion Equations.

II. **Fourier Transform**: Fourier Sine Transform, Fourier Cosine Transform, Complex Fourier Transform, Their Elementary Properties, Fourier Integral Representation, Convolution Theorem, Application to Partial Differential Equations.
   Fourier Series: Periodic Functions, Fourier Series, Even and Odd Functions, Half Range Series, Change of Interval, Harmonic Analysis.

III. **Complex Analysis**: Function of Complex Variable, Limits, Continuity; Complex Differentiation; Analytic Functions; Cauchy –Riemann Equations; Conjugate Function; Complex Integration; Cauchy's Integral Theorem; Taylor's and Laurent's Theorem.

IV. **Boundary Value Problems**: Definition, solution of wave equation, Laplace equation, Heat equation;Diffusions equation by the method of separation of variables.
   Statistics and Probability: Elementary Theory of Probability, Baye's Theorem with simple applications, Expected value, Theoretical probability distributions-Binomial, Poisson and normal distributions

V. **Numerical Analysis**: Difference operations; Forward; Backward; Central; Shift and Average Operations and Relation between them; Newton's forward and Backward interpolation; Stirlings and Bessel's central Interpolation; Lagrange's Interpolation; Numerical Differentiation and Integration, Trapezoidal Rule; Simpson's 1/3 rule and 3/8 rule.

List of Reference Books:
1. Higher Engineering Mathematics.- Gaur & Koul
2. Mathematics III: Mehta D.M., Sharma.-Vardhan Publishers
3. Advanced Engineering Mathematics.- Kreyszig E. Wiley Eastern.
4. Numerical Methods for Scientists and Engineers.- Jain M.K., Iyengar S.R.K., Wiley Eastern.
5. Fourier Series & Bondary Value Problems, James Brawn and Churchill.-Tata McGraw Hill.

BME 302 ENGINEERING THERMODYNAMICS -I

Teaching Hrs.   Exam Hrs. – 3
L-4 T-1 P-0   Marks: Theory Exam.-80 Term Test – 20 Total 100
Unit

I. **Basic Concepts of Thermodynamics :** Macroscopic and Microscopic approach, thermodynamic system, control volume, properties, state, process, Thermodynamic equilibrium, quastatic Process and cycle. Zeroth law of thermodynamics, thermometry, temperature scale, international temperature scale, Ideal gas and laws, universal gas constant. Heat and work transfer, displacement work in various processes.

II. **Properties of pure substance:** Solid-liquid-vapour phase equilibrium in pure substance, PVT surfaces, Development of tables for thermodynamic properties, quality of steam, Mollier diagram. Representation of Various processes on P-v, T-s and mollier chart, problems through steam tables and mollier chart**.**

III. **First law of Thermodynamics:** Law of conservation of energy, application to cyclic process and non cyclic process. Internal energy a property, specific heats, enthalpy, property changes in process, corollaries, applications to steady flow processes

IV. **Second law of Thermodynamics and Entropy:** Limitations of first law, heat engine, refrigerator, heat pump, Kelvin Planck and Clausius statements and their equivalence. Reversible process, irreversible process and causes of irreversibility. Carnot engine, efficiency; Carnot refrigerator, coefficient of performance, Carnot theorem and corollary. Thermodynamic temperature scale. Entropy, clausius theorem, clausius inequality, entropy a property, T-s plot, Entropy change for various processes (ideal gas). Entropy principle and applications, entropy changes in closed and open systems

V. **Availability and Irreversibility, Thermodynamics Relations**: Available energy, quality of energy, law of degradation of energy, Reversible work in open and closed systems, useful work, Availability of steady flow process and non flow process. Irreversibility, 2nd law analysis. Important mathematical relations, Maxwell relations, specific heat, entropy and energy relations, Joule Kelvin coefficient, Clausius Clapeyron's equation, applications to gases; Gibbs, Helmholtz functions

List of Reference Books:
1. Engineering Thermodynamics by P.K. Nag.- Tata Mcgraw-Hill.
2. Thermal Science and Engineering by D.S. Kumar,.- S.K. Kataria and Sons, New Delhi
3. Fundamental of Classical Thermodynamics by G.J. Van Wylen and R.E. Sonntag
   (S.I. Units) John Willey
4. Thermal Engineering Vol-1, M.L. Mathur and F.S. Mehta.- Jain Brothers, New Dehli.

BME 303 MATERIALS TECHNOLOGY

Teaching Hrs.   **Exam Hrs. – 3**
L-3 T-0 P-0   **Marks: Theory Exam.-80 Term Test – 20 Total 100**
Unit

I. **Crystal Structure:** Mechanism of crystallization; unit cells, space lattice and lattice constants; Crystal systems, and Bravias Lattices; Body centered cubic, Face centered cubic and Hexagonal closed packed structure; Miller indices for planes and directions; Crystal imperfections; point defects, lime defects and surface defects.

II. **Plastic Deformation of Metals:** The tensile stress strain curve, Deformation by slip & by twinning, Dislocation theory, Theory of work hardening its effect on properties of metals, Recovery, Recrystallisation and grain growth; Introduction to creep, fracture and fatigue behavior of metals

III. **Phase Diagrams:** Definition of phase, Equilibrium cooling of pure metals and binary alloys. Hume Rothery rule for solid solubility, Types of solid solution. Definition of phase diagram & objectives, Gibbs Phase rule. Classifications of phase diagrams, construction of phase diagram, Interpretation of phase diagrams, relationship with microstructure, Eutectic, Euteitoid and Peritectic reactions, Allotropy of iron, Iron-Iron carbide equilibrium diagram & microstructures

IV. **Heat Treatment of Steels:** Definition, principle, and purpose of heat treatment. Description of heat treatment methods: Hardening, Annealing, Normalizing, Tempering and case hardening with microstructure changes. Mar-temping & Austempering, Hardenability and its determination. Precipitation Hardening. Isothermal Transformation of steel, Transformation on continuous cooling, Critical cooling rate, Heat treatment furnace

V. **Engineering Materials:** Classification of plain carbon steels; composition, properties & applications of low, medium & high carbon steels. Alloysteels: Free cutting steels; structural steel, spring steel, tool steel, high speed steels, stainless steels. Effects of alloy element on properties of steels. Type of Cast irons: composition, properties & applications of each. Properties of aluminium; alloy of aluminium, (wrought & cast alloys). Duralumin & Y-alloy; properties of copper, copper alloys (Brasses & Bronzes); Biomaterials

List of Reference Books:
1. Introduction to physical Metallurgy by Sidney H. Avnen,.- Tata McGraw-Hill
2. Material Science & Metallurgy for Engineering by Dr.V.D. Kodgire.- Everest Pub. House, Pune.
3. Materials Science & Engineering by V. Raghavan.- Prentice Hall of India, New Delhi.
4. Heat Treatment principles & Technology by T.V. Rajan, O.P. sharma.-
5. Engineering Metallurgy Part –I by Raymond A. Higgins, ELBS.
6. Introduction to Engineering materials by B.K. Agrawal.-
7. Physical Metallurgy for Engineering by Donald S. Clark & Willbur R. Varney, EWP.

BME 304 KINEMATICS OF MACHINES

Teaching Hrs.   **Exam Hrs. – 3**
L-3 T-1 P-0   **Marks: Theory Exam.-80 Term Test – 20 Total 100**
Unit

I.   **Kinematics**: Elements, pairs, mechanisms, four bar chain and its inversions, velocity and acceleration, Klein's construction, coriolis component, instantaneous center method, synthesis of mechanisms, panto graph, scott- Russel, Tchbeicheff straight line, indicator diagram mechanisms.

II.   **Automotive Vehicle Mechanisms**: Overhead valve mechanism, Davis and Ackerman steering mechanism, Trifler suspension and Hooke's joint.
Power Transmission: Belts and ropes, effect of centrifugal force, creep, chain drive

III. **Friction**: Laws of static, dynamic and rolling friction, dry and viscous friction, inclined plane and screw jack, pivots and friction axis, bearing, clutches, theory of film lubrication.
Brakes: Band, block and band & block brakes, internal expanding brakes, braking of a vehicle.

IV. **Dynamometers:** Absorption and transmission type dynamometers, prony, rope and hydraulic dynamometers.

V.   **Cams**: Type of cams, displacement, velocity and acceleration curves for different cam followers, consideration of pressure angle and wear, analysis of motion of followers for cams with specified contours.

List of Reference Books:
1. Theory of Machines by S.S. Ratan.- Tata McGraw-Hill.
2. Theory of Machines and Mechanisms by P.L. Ballaney.- Khanna Pub.
3. Theory of Machines by B.K. Sarkar.- Tata McGraw Hill
4. Theory of Machines by Sadhu Singh – Pearson
5. Theory of Machines by V.P. Singh – Dhanpat Rai & Co.

BME 305 OBJECT ORIENTED PROGRAMMING IN C++

Teaching Hrs.   **Exam Hrs. – 3**
L-3 T-0 P-0   **Marks: Theory Exam.-80 Term Test – 20 Total 100**
Unit

I.   **Introduction to Object Oriented Programming:** Basic concepts: Class, Object, Method, Message passing, Inheritance, Encapsulation, Abstraction, Polymorphism.

II.   **Basics of C++ Environment:** Variables; Operators; Functions; user defined, passing by reference, passing an array to the function, inline function, scope, overloading; Pointers: objects and lvalue, arrays and pointers, the new and delete operators, dynamic arrays, arrays of pointers and pointers to arrays, pointers to pointers and functions; Strings: String I/O, character functions in ctype.h, string functions in string.h.

III. **Object oriented concepts using C++:** Classes: Member functions, Friend functions, Constructors, Access functions, Private member functions, class destructor, static data and function members; Overloading: inline functions, this operator, overloading various types of operators, conversion operators; the String Class; Composition and Inheritance: Hierarchy and types of inheritance, protected class members, private versus protected access, virtual functions and polymorphism, virtual destructors, abstract base classes.

IV. **Templates and Iterators:** function and class templates, container classes, subclass templates, iterator classes; Libraries: standard C++ library, contents of a standard C headers, string streams, file processing: Files and streams classes, text files, binary files, classification of files, the standard template library

V.   **Data Structures Using C++:** Linked lists – Singly linked list, Doubly linked lists, Circular lists, Stacks and Queues priority Queues, Stacks, Queues.

List of Reference Books:
1. The Complete Reference C++: Patrick Naughton, Herbert Schidt, Tata McGraw Hill.
2. Object Oriented Programming with C++: E. Balagurusamy, Tata McGraw Hill.

BME 306 MECHANICS OF SOLIDS

Teaching Hrs.   **Exam Hrs. – 3**
L-3 T-1 P-0   Marks: Theory Exam.-80 Term Test – 20 Total 100
Unit

I.   **Stress & Strain**: Tension, compression, shearing stress & strain; Poisson's ratio: Stress-strain relationship, Hooke's law; equations of static equilibrium for 2D & 3D. Elastic constants and their relations for a isotropic hookean material, anisotropy & orthotropy, thermal stresses, composite bars; simple elastic, plastic & visco-elastic behavior of common materials in tension and compression test, stress-strain curves. Concept of factor of safety & permissible stress. Conditions for equilibrium. Concept of free body diagram; Introduction to mechanics of deformable bodies

II.   **Members Subjected To Flexural Loads**: Theory of simple bending, bending moment and shear force diagrams for different types of static loading and support conditions on beams. Bending stresses, Section modulus and transverse shear stress distribution in circular, hollow circular, I, Box, T, angle sections etc.

III.   **Principal Planes, Stresses & Strains**: Members subjected to combined axial, bending & Torsional loads, maximum normal & shear stresses; Concept of equivalent bending & equivalent twisting moments: Mohr's circle of stress & strain. Theories of Elastic Failures: The necessity for a theory, different theories, significance and comparison, applications

IV.   **Torsion**: Torsional shear stress in solid, hollow and stepped circular shafts, angular deflection and power transmission capacity. Stability of equilibrium: Instability & elastic stability. Long & short columns, ideal strut, Euler's formula for crippling load for columns of different ends, concept of equivalent length, eccentric loading, Rankine formula and other empirical relations

V.   **Transverse Deflection of Beams**: Relation between deflection, bending moment, shear force and load, Transverse deflection of beams and shaft under static loading, area moment method, Double integration method: method of superposition and conjugate beam method. Various approaches to determine deflection and stresses in beam.
       Elastic strain energy: Strain energy due to axial, bending and Torsional loads; stresses due to suddenly applied loads; use of energy theorems to determine deflections of beams and twist of shafts.
       Castigliano's theorem. Maxwell's theorem of reciprocal deflections.

List of Reference Books:
1. Mechanics of Solids by B.C. Punmia, A.K. Jain, Laxmi Pub. Ltd.
2. Strength of Materials by R.K. Rajput, S. Chand & Co. Ltd.
3. Strength of Materials by G.H. Ryder, ELBS Pub. Co. London
4. Strength of Materials by R.S. Lehri , S.K.katariya & Sons ,Delhi
5. Advanced Mechanics of Solids by L.S. Srinath; McGraw Hill International Edition,

GE 307 A* Special Mathematics I**
(Common for all branches CSE/ECE/IT/ME/CSE/CIVIL for Diploma Holders)

Teaching Hrs.   Exam Hrs. 3 Hrs.
3L + 1T   Total-100

I.	**Trigonometry**	Trigonometric functions, simple identities, range and values of trigonometric functions, inverse functions, De movier's theorem, Euler's theorem
II.	**Basic Algebra**	Binomial theorem for positive and negative index, logarithmic and simple properties, exponential, Logarithmic and trigonometric series.
III.	**Differential Calculus:**	Function, single variable and multivariable function, polynomial, trigonometric, logarithmic and exponential fun's, derivative of a function, elementary formulae
IV.	**Differential Calculus:**	Derivative of sum and difference of two functions, derivative of product and quotient of two functions, logarithmic differentiation, partial differentiation
V.	**Integral Calculus:**	Integration of a function standard integrals and properties, integration by Substitution, Integration by parts, definite integral and properties.

** It will be Sessional paper: marks shall not be counted for awarding division.

II B. TECH. IV Semester

BME 401 FLUID MECHANICS

Teaching Hrs.   **Exam Hrs. – 3**
L-3 T-1 P-0   **Marks: Theory Exam.-80 Term Test – 20Total 100**

Unit

I.
Introduction: Definition of fluid- incompressible and compressible fluids, Fluid as a continuum, Fluid properties, Mass Density, Specific volume, Bulk Modulus, velocity of sound. Fluid viscosity,Newtonian fluid, Kinematic viscosity, Effect of temperature and pressure on viscosity, surface tension, capillarity; vapour pressure and cavitation.
Fluid Statics: General differential equation, Hydrostatics, Manometry. Fluid forces on Plane and curved submerged surfaces, Aerostatics, isothermal atmosphere, polytropic atmosphere. The International standard atmosphere. Static stability of floating bodies

II.
Kinematics and conservation of mass: Flow classifications, Fluid velocity and acceleration, streamlines and the stream tube. Path lines and streak lines. Deformation of a fluid element vertically and circulation, Irrotational and Rotational Flows. Flow net, Laplace equation. Conservation of mass and the continuity equation for three dimensions.Equation of motion, Euler's equation of motion, Integration of Euler's equation of motion. Bernoulli's equation. Application of Bernoulli's equationpitot tube, Venturimeter. Equation of matter for Viscous fluid. Navier-stokes equation. Orifice discharging free Jet, Vena contracta, co-efficients of contraction, velocity and discharge. Orifices and mouthpieces, Nozzles and weirs
Fluid Momentum: The Momentum theorem, Applications of the momentum theorem

III.
Flow through Pipes: Reynolds's experiment, Darcy-Weisback equation, loss of head due to sudden enlargement, contraction, entrance, exit obstruction, bend pipe fittings. Total energy and Hydraulic gradient lines. Flow through pipe line, Pipes in series and parallel, Equivalent pipe. Transmission of power through pipes. Water hammer in pipes.
Laminar Flow: Simple Solution of Navier-stokes equations, Plain & Couette flow and Hagen Poiseuille flow.

IV.
Turbulent Flow: Turbulence in pipe flow. The Prandtl Mixing length hypothesis applied to pipe flow,Variation of friction factor with Reynolds number, velocity distribution in smooth and rough pipes.The Universal pipe friction laws, Colebrook-White formula.
Dimensional Analysis: Units and dimensions. Dimensional analysis using Buckingham's theorem, Similitude and Model testing.
Force ratios: Reynolds number, Froude number, Mach number, Weber number and Euler number, and their applications. Undistorted model, Distorted model and scale ratio for distorted model. Scale effect.

V.
The Boundary Layer: Description of the boundary layer. Boundary layer thickness, boundary layer separation and control. The Prandtl boundary layer equation. Solution for laminar boundary layer. The momentum equation for the boundary layer. The flat plate in uniform free stream with zero pressure gradients.
Flow Round A Body: Drag, friction drag, pressure drag, combined skin friction and pressure drag. Flow past-sphere and cylinder. Magnus effect, Airfoil theory. Induced drag.

List of Reference Books:
1. Fluid Mechanics and Machines by V.P. Gupta and Alam Singh, CBS Publications
2. Fluid Mechanics and Fluid Power Engineering by D.S. Kumar, S.K.kataraya & Sons,Delhi
3. Hydraulics and Fluid Mechanics including Hydraulic Machines by P.N. Modi, S.M. Seth; Standard Book House, Delhi.
4. Fluid Mechanics & Hydraulics with computer application by Jagdish Lal, Matropolitan Books Co. Pvt.Ltd.

BME 402 ENGINEERING THERMODYNAMICS -II

Teaching Hrs.   **Exam Hrs. – 3**
L-4 T-1 P-0   **Marks: Theory Exam.-80 Term Test – 20 Total 100**

I. **PVT relationship for Ideal gas and real gas:** Vander wall's equation, other equations of state, Compressibility factor, law of corresponding states, use of generalized compressibility chart, Gas mixture; laws of gas mixture, relations for molecular weight, gas constant, entropy, and specific heat of mixtures; Gravimetric and volumetric analysis; gas and vapour mixture.

II. **Steam Boilers:** Classifications, simple vertical boiler, Cochran, Lancashire boiler Babcock and Wilcox boiler, mountings accessories, Boiler performance, Heat balance sheet.
Steam Nozzles: Types of nozzles steady flow energy equation in nozzles, friction, condition for maximum discharge through a nozzle, diameter of throat and exit, supersaturated flow through nozzle.

III. **Vapour Power Cycle**: Simple steam power plant, Carnot cycle, Rankine cycle, actual cycle. Reheat, regenerative feed heating, water extraction cycle, process heat and by- product power, ideal working fluid, Binary vapour power cycle, Thermal efficiency, work ratio, specific steam consumption, factors affecting these efficiencies in steam power plant, state point locus, reheat factor. The reversed carnot cycle and bell Coleman cycle, introduction to vapour compression cycle.

IV. **Gas Power Cycle:** Otto, Diesel, and Dual cycles, Air standard efficiency, mean effective pressure. Stirling, Ericsson Atkinson, and Joule cycle, air standard efficiency, comparison among Otto, Diesel and Dual cycles. Actual petrol and Diesel engine cycles.

V. **I.C. Engine & Compressors:** Classification, Two and Four Stroke Petrol and diesel engines, construction and working, valve timing diagram. Comparison between petrol and diesel engine and between two stroke and four stroke engines. Introduction to performance parameters. Reciprocating compressors, work done, single stage, effect of clearance, volumetric efficiency, indicated diagram, multi stage compressor, condition for maximum efficiency, work done, inter cooler, free air delivery.

List of Reference Books:
1. Engineering Thermodynamics by P.K. Nag, Tata McGraw-Hill.
2. Thermal Science and Engineering by D.S. Kumar, S.K. Kataria and Sons, New Delhi
3. Fundamental of Classical Thermodynamics by G.J. Van Wylen and R.E. Sonntag
   (S.I. Units) John Willey
4. Thermal Engineering Vol-2, M.L. Mathur and F.S. Mehta, Jain Brothers, New Dehli.

BME 403 MANUFACTURING SCIENCE-I

Teaching Hrs.   **Exam Hrs. – 3**
L-3 T-0 P-0   **Marks: Theory Exam.-80 Term Test – 20 Total 100**

I. **Foundry Technology**, Molding materials and types of molding sands, properties of molding sands, **Molding methods:** Green, Dry and floor molding; Shell modling: and Carbon dioxide molding.
Casting methods: Die Casting, centrifugal casting; Investment casting; permanent mould casting. Advantages, limitation and application of each. Casting defects causes and remedies. Introduction to core & core making

II. **Melting furnaces:** Constructional features & working of copula, Charge Calculation, Electric arc furnaces, Pit, Tilting, their operation & applications.
Welding Processes: Submerged are welding , Gas metal arc welding (MIG), Gas tungsten arc welding (TIG), Thermit welding, Electro slag welding, Plasma are welding, Atomic Hydrogen welding, Spot welding, Seam welding, Projection welding, Flash welding

III. **Metal Working & Metal forming processes**: Hot & cold working of metals advantage and disadvantage Principles of rolling, Types of rolling mills. Forward, Backward & Impact extrusion:
Power forging: Die forging, Drop hammers & press forging.
Sheet metal forming: Classifications of Presses, Press operations: shearing; drawing, squeezing, deep drawing, coining & embossing. Compound and progressive dies, punch and dies set.

IV. **Powder Metallurgy:** Methods of powder manufacturing; Mechanical pulverization; Electrolytic process; Chemical reduction process; Atomization process. Blending; Compacting and sintering process Characteristics of metal powder, advantages, disadvantages & applications of powder metallurgy.

V. **Machine Tools:** Constructional details, Working principle and specifications of centre lathe, Shaper and Drilling machine and Milling machine; Common operations related to above machines, Indexing head and indexing methods;

List of Reference Books :
1. Production Technology (Manufacturing Processes) by P.C. Sharma , S. Chand,
2. Principles of Manufacturing Material & Processes by J.S. Campbell, Tata Mc Graw Hill.
3. Workshop Technology Vol.-I,II by S.K. Hajra choudhary, Media Promoters & Publishers Pvt. Ltd. .
4. Manufacturing Technology by P.N. Rao, Tata McGraw Hill.
5. Foundry Technology by M. lal Dhanpat Rai Pub.
6. Welding Engineering & Technology by Dr. R.S. Parmar, Khanna Pub.
7. Power Metallurgy by A.K. Sinha, Dhanpat Rai Pub.
8. Welding & Welding Technolgoy by Richard L. Little, Tata McGraw Hill.

BME 404 DYNAMICS OF MACHINES

Teaching Hrs.   **Exam Hrs. – 3**
L-3 T-1 P-0   **Marks: Theory Exam.-80 Term Test – 20 Total 100**

Unit

I.
Governors: Watt, Porter, Proell, Hartnell and spring controlled governors, governor effort, power, stability, inertia effects.
Gyroscope: Principle of gyroscopic couple, effect of gyroscopic couple and centrifugal force on vehicle taking a turn, stabilization of sea vessels.

II.
Gears: Law of gearing, terminology, tooth form, standard interchangeable tooth profile, minimum number of teeth on pinion in contact with gear or rack, interference and undercutting, bevel, helical and spiral gears.

III.
Gear Trains: Simple, compound, reverted and epicyclic gear trains, analytical, tabular, graphical and vector methods for velocity ratio, gear boxes-sliding and constant mesh for automobiles.

IV.
Balancing: Balancing of rotating masses, balancing of reciprocating masses, locomotives, IC engines, balancing machines

V.
Inertia Force Analysis: Velocity and acceleration of slider crank mechanism and four bar mechanism, inertia force, piston thrust and forces on connecting rod, turning moment diagram and flywheel

List of Reference Books:
1. Theory of Machines by S.S. Ratan; Tata McGraw-Hill Pvt. Ltd.
2. Theory of Machines and Mechanisms by P.L. Ballaney; Khanna Pub.
3. Theory of Machines by B.K. Sarkar; Tata McGraw Hill Pvt. Ltd.
4. Theory of Machines by Sadhu Singh – Pearson
5. Theory of Machines by V.P. Singh – Dhanpat Rai & Co.

BME 405 INSTRUMENTATION & CONTROL

Teaching Hrs.   **Exam Hrs. – 3**
L-3 T-0 P-0   **Marks: Theory Exam.-80 Term Test – 20 Total 100**

Unit

I.
System configuration, basic characteristic, calibration, classification and performance characteristics of a instrumentation system, Specification and testing of dynamic response.
Strain Measurement : Electric Strain Gauges - Types; Selection and Installation, Strain gauge circuits; temperature compensation and calibration; Use of Strain Gauges on Rotating Shafts, Load Cells, Mechanical and Optical Strain Gauges.

II.
Various Mechanical, Electro- Mechanical & Photoelectrical Sensors for sensing of Displacement, Velocity, Acceleration, Torque, Force, Temperature from Low to High ange, flow, level of fluid , pressure, angular speed, voltage, frequency and current

III.
Introduction to Multi-Channel Data-Acquisition System, Measurement Pods, Interface Hardware, Data Analysis Software, Interfacing. Concepts and examples of automatic control systems, systems by differential equations, transfer function, block diagram, open and feed back control systems, signal flow graphs & its constructions. Control System components, error sensing devices and servo motors.

IV.
Control for mechanical systems & processes; speed control system for steam/gas turbines. A constant tension reeling system, Electro-mechanical systems. Thermal systems, Pneumatic systems; Mathematical Models of physical systems, Feed back characteristics of Control Systems. Time response analysis; transient response analysis, time response specifications, steady state-error.

Concepts of stability, Routh-Hurwiz stability criterion, relative stability. The root locus
V. technique, use of construction rules without any derivation. Frequency response analysis, Polar
plots; stability in frequency domain, Bode / Logarithmic plots. Nyquist stability criterion.

List of Reference Books:

1. Control systems engineering, I.J. Nagrath & M. Gopal, Wyle Eastern Ltd.
2. Automatic Control Engg., F.H. Raxen. McGraw Hill, International Edition.
3. Modern Control Engineering, J.K.Ogata, Prentice Hall of India Pvt. Ltd. New Delhi.

BME 406 ADVANCE MECHANICS OF SOLIDS

Teaching Hrs.   **Exam Hrs. – 3**
L-3 T-1 P-0   **Marks: Theory Exam.-80 Term Test – 20 Total 100**

Unit

I. **Analysis of stresses in 3-Dimensions**: Body force, surface force and stress vectors, state
of stress at a point, normal shear stress components, stress component on arbitrary plane,
principal stresses in 3-Dimentions, stress invariants, decomposition of stress matrix into
hydrostatic and pure shear states, Lame's stress ellipsoid, differential equations of
equilibrium

II. **Analysis of strain in 3-Dimensions**: introduction, deformation in neighborhood of a
point, change of length of linear element, state of strain at a point, principal axes of strain
and principal strains, compatibility conditions

III. **Stress strain relations** for linearity elastic bodies, generalized Hooke's law, Stress-strain
Relations for anisotropic, orthotropic and isotropic materials.

IV. **Bending of curved beam** (Winkler Bach formula), Stresses in ring, stresses in chain link
unsymmetrical bending of beams, shear centre.

V. **Cylinders**: Thin cylinder stresses, spherical shell. Thick cylinder, shrunk cylinder,
Thick spherical shell, stresses in rotating disc. Disc of uniform strength.

List of Reference Books:

1. Mechanics of Solids by S.H. Crandall, N.C. Dahl & T.J. Lardner; McGraw Hill International Edition,
2. Advanced Mechanics of Solids by L.S. Srinath; McGraw Hill International Edition,
3. Strength of Material by G.H. Ryder, ELBS Pub. Co. London,
4. Mechanical of solids, B.C. Punmia, Laxmi Pub. Ltd. Delhi
5. Solid of Mechanics by S.M.A. Kazimi; Tata McGraw Hill Pub. Co. Ltd, N. Delhi.
6. Strength of Material by R.S. Lahri, S.K. Kataria & Sons Delhi

GE 407 A* Special Mathematics II**
(Common for all branches CSE/ECE/IT/ME/CSE/CIVIL for Diploma Holders)

Teaching Hrs.   **Exam Hrs. 3 Hrs.**
3L + 1T   **Total-100**

Unit	Topics	
I.	**Differential equation of first Order**	Definition, order and degree of differential equation, Method of separation of variable, Homogeneous differential equation.
II.	**Differential equation of first Order**	Exact differential equation of first order, Reducible to exact form, Linear form, Reducible to linear form.
III.	**Differential equation of second Order**	Linear differential equation with constant coefficients, complementary function, particular integral
IV.	**Elementary Complex Variable**	Complex Numbers, Real and imaginary parts of complex, complex conjugate, modulus and argument of complex umber. Euler's theorem and De'moivre's theorem (only statement) polar form of complex number.
V.	**Matrices and Determinants**	Determinants and Matrices of order two and three properties of determinants, Evaluation of Determinants, Addition, Subtraction, Multiplication, Transpose, Adjoint and inverse of Matrix.

** It will be Sessional paper: marks shell not be counted for awarding division.

BME 501 FLUID MACHINES

Teaching Hrs.   Exam Hrs. – 3
L-3 T-1 P-0   Marks: Theory Exam.-80 Term Test – 20 Total 100

Unit

I.   **Introduction:** Application of the momentum, and moment of momentum equations to flow through hydraulic machinery, Euler's fundamental equation, Classification of machines.
Dynamics of free jet: Impact of free jet on single and series of plates-plane and curved. Calculation of forces, work done, and efficiency. Jet striking centrally, inclined, tangentially. Velocity vector diagrams.

II. **Hydraulic Turbines:** Classification of turbines, Impulse turbine, Constructional details, velocity triangles, power and efficiency calculations, governing of Pelton wheels, Reaction turbines, Francis and Kaplan turbines, constructional details; Velocity triangles, power and efficiency calculation; degree of reaction, draft tube, cavitations. Unit and specific quantities, performance characteristics of water turbines.

III. **Centrifugal Pump**: Classification, Centrifugal pumps, Vector diagrams, Specific speed, head, power and efficiency calculations, Parallel and series connection of pump of common pipe line. model testing, performance characteristics. Experimental determination of Pump Characteristics. Pumped storage plants.

IV. **Reciprocating Pumps:** Reciprocating pump, theory, indicator diagram, slip, effect of friction and acceleration. Theory of air vessel.
Axial Flow Pump: Description, velocity triangles, work done on the fluid, energy transfer, Axial pump characteristics, cavitations.
Selection of Pumps: Cavitations and abrasive wear of pumps, unstable operation of pump.

V.   **Miscellaneous Hydraulic Machines:** Gear pumps, Vane pumps, Hydraulic ram, Jet pumps, Well pumps, Air lift pump, reversible hydraulic machines (pump turbine). Type, construction and their Characteristics.
Hydraulic Power Transmission: Hydro kinematics systems, methods of control, constant and variable delivery systems, common uses of hydrostatic systems, Hydro-kinematics transmission systems, theory of hydraulic couplings and torque convertors, operating characteristics, Kinematics

List of Reference Books:

1. Fluid Mechanics and Machines by V.P. Gupta, Alam Singh, CBS Publications.
2. Hydraulics and Fluid Mechanics including Hydraulic Machines by P.N. Modi,
   S.M. Seth; Standard Book House, Delhi,
3. Fluid Mechanics and Fluid Power Engineering by D.S. Kumar, S.K. Katariya & Sons, Delhi,
4. Fluid Mechanics and Hydraulic Machines by R.K. Bansal, Laxmi Pub. Pvt. Ltd.
5. Fluid Machines by S.S. Rattan, Khanna Pub.

BME 502   I.C. ENGINES

Teaching Hrs.   Exam Hrs. – 3
L-4 T-0 P-0   Marks: Theory Exam.-80 Term Test – 20 Total 100

Unit

I.   **Combustion in S.I. Engines:** The Process of combustion, Effects of engine variables on ignition lag flame propagation, abnormal combustion, knocking, effects and control of knock, Knock theory, effe engine variable on knock, S.I. Engine fuel properties, Knock rating of fuel, octane number, additives, requirements of combustion chamber, Design Principles, Types of combustion chambers, merits.

II. **Combustion in C.I. Engines:** Combustion Process, Stages, diesel knock, effects of operating parameters on knock, knock Control, rating of C.I. engine fuels, Cetane number, types and requirements of the combustion chambers, merits
Emission and Control : SI and CI engine emissions, effects of pollutants on human health and biologi sphere, Control of emissions from SI and CI Engines, Introduction to Noise Pollution & its Control

III. **Engine Operating Systems:** Valves and valve gear, lubrication systems, and system components, lubricating oils, properties and rating, additives. Cooling systems, temperature gradients in engine parts, various methods of cooling, Power absorbed in cooling, Properties of coolants, additives. Fuel systems for SI and CI engines, F/A ratio requirements for different operating conditions, fuel transfer pump, fuel injection pump, injector, Modern carburetors, MPFI in SI engines. Conventional & Modern Ignition system, firing order.

IV. **Engine Performance:** Testing of Engines - their performance characteristics, Heat Balance sheet, Scavenging processes, Volumetric, charging and scavenging efficiencies, scavenging methods and systems of four stroke and two stroke engines.

V. **Supercharging:** Supercharging suitability for SI and CI engines, methods of supercharging, types of supercharging, Analysis and performance, Introduction to special engines like free piston, multi-fuel, wankel rotary, dual fuel engines, adiabatic engines, Stratified engine.

List of Reference Books:
1. I.C. Engine by M.L. Mathur, R.P.Sharma; Dhatpat Rai Pub.
2. I.C. Engine by V. Ganeshan ; Tata McGra Hill.
3. I.C. Engines by Anand V. Domkundwar, V.M. Domkundwar; Dhatpat Rai Pub

BME 503 MANUFACTURING SCIENCE -II

Teaching Hrs.   **Exam Hrs. – 3**
L-3 T-0 P-0   **Marks: Theory Exam.-80 Term Test – 20 Total 100**
Unit

I
Geometry of Cutting Tool: Geometry of single point cutting tool, tool angles, and their role in cutting operation. Reference planes, tool nomenclature in ASA and ORS system;, Inter relation ship positive & negative rake angles, Types of milling cutter and their nomenclatures, Types of twist drills and their nomenclatures, Metal machining process; Orthogonal cutting and oblique cutting.

II
Theory of Metal Cutting: Mechanism of chip formation; Types of chips; chip breaker. Determination of shear angle, Determination of chip thickness ratio, forces on the chip; Merchant force diagram, Velocity relation ship; stress & strain in chip, power and energy relation ship; in orthogonal cutting. Thermal aspects of metal machining; measurement of chip tool interface temperature, Friction in metal cutting, Power required in milling, Torque and thrust in drilling operations.

III
Theory of Machinability: Definition; Evaluation of machinability; Tool life; Types of tool failure; flank wear , crater wear; variables effecting tool failure and tool life, cutting forces, machinability index; surface finish, Economics of metal cutting, Cutting fluids, types of cutting fluid, Functional
Requirements of cutting fluid, Methods of application of cutting fluids

IV
Principles of Interchangeability: Terminology for limits and fits, types of fits, hole basis and shaft basis systems, unilateral and bilateral tolerances. Designation of holes, shafts, and fits.
Precision Measuring Instruments: Comparators, Optical flats, Auto-collimator- their types, Working principle, applications and limitations, Types of plane gauges.

V
Precision Measurement: Standards of linear measurements; linear and angular measurements; screw thread measurements; measurement of effective diameter, pitch and thread angles; Gear measurement; spur gear parameter, measurement of tooth profile, tooth thickness and pitch, Measurement of surface roughness, stylus and profile graph methods

List of Reference Books:
1. Fundamentals of metal cutting and machine tool by B.L.Juneja & G.K.Sekhon. New Age Pub.
2. Production Engg. & Science by:-P.C. Pandey & C.K. Singh. Standard Pub. Standard Pub.
3. Metal cutting Principles by:-Milton Shaw. CBS
4. Engineering Metrology by:- R. K. Jain. Khanna Pub.
5. Engineering Metrology by:- I.C. Gupta. Dhanpat Rai Pub.
6. A Text Book of Production Engineering by P. C. Sharma. S. Chand

BME 504 INDUSTRIAL ENGINEERING -I

Teaching Hrs.   **Exam Hrs. – 3**
L- 3 T-0 P-0   **Marks: Theory Exam.-80 Term Test – 20 Total 100**
Unit

	Introduction to Management: Principles of Management; Elements of Management; Planning, Organization Staffing, Directing, Co-ordination and Control, The Development of management thoughts with reference to the work of Taylor, Gilbreth, Mayo, Kurt and Lewin.
I.	**Business Organization**: Type of Business; Ownerships, Sole Proprietorship, Partnership, Private Limited and Public Limited Companies, their formation and dissolution. Government Control, Public Corporations. Cooperative Societies, formation and working. Types of Organization: Line, Functional, Line and Staff, Line Staff and Committee Organization, Organizational Chart, Staff Relationship, Span of Control, Authority and Responsibility, Flow in Organization
II.	**Personnel Management**: Organization, Functions and Responsibilities, Relationship with other Departments. Brief idea about Motivation, Morale, Perception, Leadership, Attitudes, Frustration, Accidents, Values, Opinion, formal and informal organization. Man power planning, Recruitment, Selection, Job Specification and Job Qualification. Training and Placement.
III.	**Interest and Depreciation**: Interest- Meaning, Compound Interest, Nominal and Effective Rate of Interest. Depreciation: Meaning and Causes, Need of Depreciation, Calculation Methods of Depreciation- Straight line method, Sinking fund method, Declining balance method, Sum of year's digit method (SYD method). Annuities -Capital Recovery Annuity, Present Worth Annuity, Sinking Funds Annuity, Compound Amount Annuity
IV.	**Demand Analysis and Revenue Function**: Basic theory of demand, Market Structure, Other influences of demand elasticity and demand level. **Element of Costing**: Classification of costs, Direct and Indirect Cost, Labour, Material and Over Head cost, Prime Cost, Factory Cost, Fixed Cost, Variable Cost, Increment Cost, Allocation of over Head Costs, Break Even Chart and Analysis.
V.	**Financial Management:** Introduction, Needs of Finance, Kinds of Capital, Sources of Finance: Shares, Debentures, and Financial institution. **Financial Statements:** (i) Profit & Loss Statement (ii) Balance Sheet Analysis of Financial statement: Financial Ratios, classification, Current ratio, Liquidity ratio, Debt-Equity ratio, Inventory turn over ratio, Profitability ratio. **Budget and Budgetary Control**: Types of Budget, Preparation of Budget, Standard Cost and variation

List of Reference Books:

1. Industrial Engineering and Production Management by M. Mahajan. Dhanpat Rai Pub
2. Industrial Engineering and Management by O. P. Khanna Dhanpat Rai Pub
3. Industrial Engineering and Management Science by T. R. Banga, N. K. Agarwal, and S. C. Sharma. Khanna Pub.

BME 505: MACHINE DESIGN-I

Teaching Hrs.   **Exam Hrs. – 3**
L-3 T-0 P-0   **Marks: Theory Exam.-80 Term Test – 20 Total 100**
UNIT

I   **Materials:** Properties and IS coding of various materials, Selection of material from Properties and economic aspects. Manufacturing aspects in Design: Selection of manufacturing processes on the basis of design and economy, Influence of rate of production, standard size, Influence of limits, fits tolerances and surface finish. Change in the shape of the designed element to facilitate its production, Design of castings, working drawing.

II **Design for strength:** Allowable stresses, detailed discussion on factor of safety (factor of ignorance): Introduction of various design considerations like strength, stiffness, weight, cost, space etc. Design of machine elements subjected to direct stress, Pin, cotter and keyed joints, Welded joints.

III **Design of members in Bending:** levers and laminated springs.

IV **Design of members in torsion:** Shafts and shaft couplings. Helical compression, tension and torsional springs. Springs under variable stresses.

V   Power Transmission: Design of belt, rope and pulley drive system, selection of chain & sprocket drive systems.

List of Reference Books:
1. Design of M/C element by V.B. Bhandhari, Tata McGraw Hill
2. Machine Design by S.C. Sharma, S.K. Kataria & Sons
3. Mechanical Engineering Design by J.E. Shigeil & C.R. Mischke, Tata McGraw Hill
4. Machine Design by R. Karwa, Laxmi Publications Delhi.
5. Design Data Hand book by K. Mahadevan & K.B. Reddy, CBS Publications New Delhi.
6. Design Data Book by PSG college of Technology, Coimbatore

BME 506 STEAM TURBINE & GAS DYNAMICS

Teaching Hrs.   **Exam Hrs. – 3**
L-4 T-1 P-0   **Marks: Theory Exam.-80 Term Test – 20 Total 100**

Unit

I.   **Basic equations:** Efficiency and utilization factor for radial flow, axial flow, impulse and reaction steam turbines. Methods of reducing rotor speed, velocity diagrams for two stages. Calculation of main blade dimensions, thrust, theoretical power; torque and optimum operating variables. Energy losses in stream turbines

II.   **Classification:** Base load, pass out, exhaust and back pressure turbines; special constructional features of steam turbines, lubrication systems; Governing: Throttle control; nozzle control and by pass governing; mechanical oil relay and emergency trip governors. Starting and stopping procedure.

III.   **Isentropic Flow:** Energy equations, stagnation state, properties, reference velocities. Velocity of sound; Mach angle; Mach number, steady isentropic flow through ducts; use of isentropic tables; condition for maximum discharge; choked flow; flow through convergent and convergent-divergent nozzle.

IV.   **Adiabatic flow and flow with Heat Transfer:** Adiabatic flow; Fanno line tables; entropy change; choking due to friction; flow through long ducts; Diabatic flow: Rayleigh line; fundamental equations, heat transfer;change in entropy, effect of change in stagnation temperature

V   **Normal Shock:** Plane stationary normal shock: Rankine-Hugoniot relations: increase in entropy: Prandtl's relations ; change in stagnation pressure across the shock

List of Reference Books:
1. Steam and Gas Turbines, R. Yadav, Central Publishing House, Allahabad
2. Thermal Engineering. Vol. , M.L.Mathur and F.S.Mehta, Jain Bros., New Delhi
3. Gas Dynamics, S. M. Yahya
4. Gas Dynamics , E. Rathakrishnan, Prentice Hall of India, New Dehli

III B. TECH. VI SEMESTER
BME 601: HEAT AND MASS TRANSFER

Teaching Hrs.   **Exam Hrs. – 3**
L- 3 T-1 P-0   **Marks: Theory Exam.-80 Term Test – 20 Total 100**

Unit

I.   **Introduction to heat transfer processes**, conduction, convection and radiation. Fourier's law of heat conduction, thermal conductivity, thermal conductivity of solids, liquids and gases, effect of temperature on thermal conductivity. Newton's law of cooling, definition of overall heat transfer coefficient. General parameters influence the value of heat transfer coefficient

II.   **Conduction :** General 3-Dimensoinal conduction equation in Cartesian , cylindrical and spherical coordinates; different kinds of boundary conditions; nature of differential equations; one dimensional heat conduction with and without heat generation; electrical analogy; heat conduction through composite walls; critical thickness of insulation.
Heat transfer from finned surfaces; fin efficiency and effectiveness, two dimensional steady state heat conduction using analytical and numerical methods, periodic heat conduction. Convection: review of Navier – Stokes and energy equation, hydrodynamic and thermal boundary layers; laminar boundary layer equations; forced convection appropriate non dimensional members; effect of Prandtl number; empirical relations for flow over a flat plate and flow through pipes.

16

Natural convection: Dimensional analysis, Grashoff number, boundary layers in external flows (flow over a flat plate only), boundary layer equations and their solutions, heat transfer correlations.

III. **Heat transfer with change of phase**: nature of vaporization phenomena; different regimes of boiling heat transfer; correlations for saturated liquid vaporization; condensation on flat plates; correlation of experimental results, drop wise condensation.

Heat exchanger: Different types of heat exchangers, arithmetic and logarithmic mean temperature differences, L.M.T.D., counter and cross flow type heat exchanger; effectiveness

IV. of heat exchanger, N.T.U.-∈ method, fouling factor. Constructional and manufacturing aspects of Heat Exchangers.

Thermal Radiation: Plank distribution law, Kirchoff's law; radiation properties, diffuse radiations; Lambert's cosine law. Radiation intensity, heat exchange between two black bodies,

V. heat exchange between gray bodies. Shape factor; electrical analogy; reradiating surfaces, Heat transfer in presence of reradiating surfaces.

List of Reference Books:

1. Heat transfer by J.P. Holman, Tata Mcgraw Hill
2. Heat & Mass Transfer, by. D.S. Kumar, S.K. Kataria & Sons
3. Heat & Mass Transfer, by Domkundwar, Dhanpat Rai & Co.

BME 602   AUTOMOBILE ENGINEERING

Teaching Hrs.   **Exam Hrs. – 3**
L- 3 T-0 P-0   **Marks: Theory Exam.-80 Term Test – 20 Total 100**
Unit

I   **Chassis Frames**: Conventional and Integral Chassis frames and terminology; Functions and requirement of chassis frame; Design factor and forces on chassis frame.
Vehicle Body: Types of vehicle body, Integral body; Component of vehicle body; Design aspects & requirements; Aerodynamic consideration for body design; chassis layout and terminology like wheel base, track width, turning radius etc.

Suspension System: Types of suspension springs (leaf, coil, torsion bar & air spring) Function & requisites of a good suspension system; **Types of suspension systems:** Rigid front & rear suspension and Independent front & rear suspension, sprung weight and un-sprung weight. Telescopic damper, Difference between rigid & independent suspension system.

II   **Clutches:** Functions and requirement of a cultch; Single plate (coiling & diaphragm spring type), Multi-plate, Centrifugal, Electromagnetic, Vacuum and Hydraulic clutches and Fluid coupling its advantages & disadvantages.
Gear boxes: Function of gear box; Working principle; Construction and working of constant mesh gear box; Sliding mesh gear box; Synchromesh gear box; Epicycle gear box; Over drive; Torque converter.
Drive Lines: Propeller shaft; Universal joint; Slip joint; Final drives gears; Construction & Working of differential gear box; Front wheel drive, four wheel drives. **Types of rear axles:** Hotchkiss and Torque tube type.

III **Steering System:** Functions and requirement; Fundamental of steering; Ackermen steering linkage ; Steering system components; Types of steering gear boxes; Power steering; King pin inclination; Camber, Caster, Toe in and Toe out and their effect on steering geometry; Under & over steering.
Braking System: Function and requirement of braking system; Mechanical, Hydraulic, Air, Vacuum and disk brake Difference between Disc brake & Drum brakes, self energized brake. Brake shoes and friction lining materials. Brake fluid characteristics and types.

IV **Automotive Battery**: Construction and working; capacity of a battery and battery efficiency; Methods charging; Testing methods. (Specific gravity test and load test);
Electrical Auxiliaries: Construction of staring motor (self start); Types of self starter driver; Principle and construction of alternator, Advantage of alternator over dynamo.
Ignition System: Coil ignition systems, its components and working. Types of electronic ignition system (Distributor type and Distributor less type) and working: Advantages of electronic ignition system.

V   **Wheels and Tyres:** Essential requirements of a wheel; Types of wheel (pressed wheel, wire wheel & light alloy wheels) nomenclature of pressed wheel, advantages of alloy wheel.

Tyres: Functions and requisites of a tyre; **Type of Tyres:** Conventional tube and tubeless treys; **Tyre construction:** Cross-ply and radial ply construction; Advantages & disadvantages of radial tyres; Tyre materials; Tread pattern: Tyre size; Tyre inflation pressure: Tyre rotation; Tyre wear & their causes.

Automotive Air Conditioning: Ventilation system; Heating system and Air Conditioning system.

Automotive Emission Control: Measurement of exhaust emission; Method of emission control; Catalytic converter.

List of Reference Books:
1. Automotive Mechanism by William H Crouse & Donald L Angilin Taha; McGraw Hill
2. Automobile Engg. Vol I by K.M. Gupta; Umesh Pub. , Delhi
3. Basic Automobile Engg. by C.P. Nakra; Dhanpat Rai Pub Co. , Delhi
4. Automobile Engg. by K.K. Ramlingam; Scientific Pub. Pvt Ltd, Pune
5. Automotive Mechanics, by S. Srinivason; Pub. Tata McGraw-hill
6. Automobile Technology by N.K. Giri, Khanna Publisher.
7. Automobile Technology by Kripal Singh;

BME 603   MANUFACTURING SCIENCE -III

Teaching Hrs.   **Exam Hrs. – 3**
L- 3 T-0   P-0   **Marks: Theory Exam.-80 Term Test – 20 Total 100**

Unit

I Jigs & Fixtures: Introduction, definition and differences; usefulness of jigs & fixtures; principles of jigs & fixture design; locating and clamping; Jig bushes; drilling jigs; Milling fixtures; Boring fixture; Broaching fixture; welding fixture; assembly fixture; indexing devices; Materials for Jigs & Fixture; Economics of Jigs & Fixtures.

II Unconventional Machining Methods: Classification & working principle, Electro-discharge machining (EDM); Electro-Chemical machining (ECM); Ultrasonic machining (US); Elctro-beam machining (EBM); Laser beam machining (LBM); Abrasive Jet Machining (AJM); Electrolyte grinding (EG); Advantages, Disadvantages and application of each.

III Production Machine Tools: Capstan & turret Lathes, Tool layout for turret, indexing mechanism of turret; swiss automatic; transfer machines; Hydraulic tracer controlled machine tool, operation planning, turret tool layout, sequence operation, economic batch quantity, selection of cutting speed, & feed, calculation of machining time; cutting time and production rate;

IV Grinding Machines: Type of grinding abrasives & their application manufacturing of grinding wheel, standard method for marking grinding wheels, dressing and truing & balancing of grinding wheels, grinding ratio, cylindrical grinding machines, centre less grinding machines, advantage disadvantages, grinding process variables

V Gear & Thread Manufacturing: Classification of methods; milling; Broaching; Gear generating; Hobbing; Gear shaping; Bevel gear cutting; worm gear; Gear finishing methods external screw thread cutting; thread milling; thread grinding. Finishing & super finish operations: Lapping; Honing; super finishing, Burnishing, Polishing & Buffing.

List of Reference Books:
1. Production Engg. And Since By :- P.C. Pandey and C.K. singh-Standard Pub.
2. Modern Machining processes By:- P.C. Pandey and H.S.Shan -Tata McGraw Hill.
3. Fundamental of Mattel Cutting and machine tool By;- B.L. Juneja and G.S.Sekhon- New Age Pub.
4. Production Technology By :- R.K. Jain- Khanna Pub.

BME 604   INDUSTRIAL ENGINEERING -II

Teaching Hrs.   **Exam Hrs. – 3**
L- 3 T-0   P-0   **Marks: Theory Exam.-80 Term Test – 20 Total 100**

Productivity: Measurement of productivity, factors affecting productivity, causes of low productivity, remedies to increase productivity, work study and productivity

I. Work Study: Purpose and scope of work study, Relation between management and labour.

Method Study: Objective and scope, recording techniques, Process chart symbols, Operation process chart, Flow process chart, Two hand process chart, Activity charts and their analysis, Flow diagram, Photographic aids and models, Simple examples of preparing the method sheets.

Motion Study: Principles of motion economy and their industrial importance, Micro motion study: Micro motion analysis, Therbligs, Preparation of film and its analysis, Simo Chart, Cycle Graph, Chronocycle Graph.

Work Measurement: Objectives of work measurement, Work Measurement techniques:

II. **Stop watch time study**: Definition, Equipments and Steps in making a time study, Number of cycles to be timed, Concept of performance rating and rating methods, Normal time, Allowances, Calculation of standard time.

Work Sampling: Introduction, Work sampling procedure, Determination of sample size, Applications, Advantages and Disadvantages.

Predetermined Motion Time Systems (PMTS): Method Time Measurements (MTM) and Work Factor (WF) systems.

III. **Quality Control:** Definition of quality, Meaning of quality control Statistical quality control (SQC) Frequency Distribution, Control chart- (1) For variables (2) For attributes. Sampling Inspection: Operating Characteristic Curve (OCC), Average Outgoing Quality (AOQ), Sampling Plans.

Plant Location: Major factors, influencing the location of an industry and choice of site.

IV. **Plant Layout**: Principles of plant layout, use of travel charts, Flow Pattern, Process Layout, Product Layout and combination. Line balancing.

V. **Materials Handling**: Functions, Engineering and economic factors, Relationship to plant layout. Selection, operation and maintenance of material handling equipment. Types of equipment.

Plant Maintenance: Maintenance policies; preventive, break down and corrective methods.

List of Reference Books:

1. Industrial Engg. & Production Management by Martand Telsang- S. Chand
2. Industrial Engineering and Production Management by M. Mahajan- Dhanpat Rai Pub. Delhi
3. Industrial Engineering and Management by O. P. Khanna- Dhanpat Rai Pub. Delhi
4. A text book of Work Study and Ergonomics by Suresh Dalela and Saurabh- Standard Pub.
5. Introduction to Work Study by I.L.O.
6. Plant layout and Material handling by G. K. Agarwal- Jain Brothers.

BME 605: MACHINE DESIGN – II

Teaching Hrs.   **Exam Hrs. – 4**
L- 3 T-0   P-0   **Marks: Theory Exam.-80 Term Test – 20 Total 100**
Unit

I. **Fatigue Considerations in Design:** Variable load, loading pattern, Endurance stresses, influence of size, surface finish, notch sensitivity & stress concentration. Goodman line, Soderberg, Design of machine members subjected to combined, steady and alternating stresses. Design for finite life. Design of Shafts under Variable Stresses.

II. **(a) Curved Beam & Power Screw:** Design of members which are curved like crane hook, body of C-clamp, machine frame etc. Power screws like lead screw, different type of screw jack.

   (b) Design of screw fastening: Pre loading of bolts, Bolts subjected to variable stresses, various Bolted joints, eccentric loading of Bolts.

III. **Design of I.C engine parts:** piston connecting rod, crank shaft, fly wheel.

IV. **Design of gear:** Lewis and Buckingham equations; wear and dynamic load considerations, Design and force analysis of spur, helical, bevel and worm gears. Bearing reactions due to gear tooth forces.

V. **Design of sliding & journal bearing:** method of lubrication, hydrodynamic, hydrostatic, boundary etc. Minimum film thickness and thermal equilibrium. Selection of anti-friction bearings for different loads and load cycles. Mounting of the bearings. Method of lubrication, selection of oil seals.

List of Reference Books:

1. Design of M/C element by V.B. Bhandhari, Tata McGraw Hill
2. Machine Design by S.C. Sharma, S.K. Kataria & Sons
3. Mechanical Engineering Design by J.E. Shigley & C.R. Mischke, Tata McGraw Hill   Machine
4. Design by R. Karwa, Laxmi Publications Delhi.
5. Design Data Hand book by K. Mahadevan & K.B. Reddy, CBS Publications New Delhi.
6. Design Data Book by PSG college of Technology, Coimbatore

BME 606 GAS TURBINES AND JET PROPULSION

Teaching Hrs.   **Exam Hrs. – 3**
L- 4 T-1 P-0   **Marks: Theory Exam.-80 Term Test – 20 Total 100**

I. **Gas Turbine Cycles:** Ideal cycles, open and closed cycles, constant pressure and volume cycles, intercooling reheat and reheat with heat exchange Ericsson cycle. Compounding – different shaft arrangements, special applications, of gas turbines such as industrial, aircraft, marine. Gas turbines in power generation, combined cycle power generation.

II. **Performance of Practical Gas Turbine Cycles:** Compressor and turbine efficiencies: pressure losses, heat exchanger thermal ratio, mechanical losses, variation of specific heats, performance calculation for simple cycle for design point Factors affecting the performance, calculation of practical gas turbine cycles, polytrophic efficiency, general performance of simple cycle with losses

III. **Centrifugal Compressors:** Principle of operation, velocity triangle, work done and pressure rise, loading coefficient, slip, Diffuser. Design criterion, compressibility effects, non-dimensional quantities used for plotting compressor characteristics, surging, choking and rotating stall gas turbine.

IV. **Axial Flow Compressors:** Basic constructional features, turbine v/s compressor blades, elementary theory, velocity triangle, stage work, stage loading, degree of reaction, vortex theory, simple design calculations, introduction to blade design, cascade test, compressibility effects, matching of compressor and turbine.

V. **Gas turbine cycles for aircraft propulsion:** Criteria of performance, intake and propelling nozzle efficiencies, simple turbojet cycle, turbofan engine, turboprop engine, thrust augmentation.
Axial Flow Turbines: Choice of blade profile. Pitch and chord, stage and overall turbine performance, cooling of turbine blades, overall turbine performance, methods of improving part-load performance, matching procedures for twin-spool and turbofan engines, transient behaviors of gas turbine. Principles of control systems

List of Reference Books:
1. Gas turbines Theory, H.Cohan, G.F.C.Roger and HIH Asravanama.longman Scientific & Technical Pub.,N.York.
2. Gas turbines and Jet and Rocket Propulsion, M.L.Mathur and R.P.Sharma, Standard Publisher & Distributor, New Delhi.
3. Turbine Compressors and Fans by S.M.Yahya Tata Mc Grew Hill.
4. Gas Turbine by V. Geneshan Tata Mc Graw Hill.

IV B. TECH. VII Semester

BME 701 COMPUTER AIDED DESIGN

Teaching Hrs.   **Exam Hrs. – 3**
L- 3 T-0 P-0   **Marks: Theory Exam.-80 Term Test – 20 Total 100**
Unit

I. **Fundamentals of CAD:** Design process. Application of computers for Design CAD workstation, wire-frame versus solid modeling.

II. **Transformations** Homogenous co-ordinates, Translation, Rotation, Reflection, Scaling, Combined, Transformation, Orthographic, Axonometric, Oblique and Perspective projections

III. **Curves** Parametric Representation of Analytic curves: Lines, Circles, Ellipses, Parabolas, Hyperbolas, Conics

IV. **Analytic Curves** Parametric Representation of Analytic Curves: Hermite cubic Spline, Bez Curves, B-Splines Curves, Rational Curves

V. **Modeling** Introduction to surface and solid modeling, windowing, clipping, viewpoint, rendering, Hidden Surface Algorithms, hidden surface and line removal.

List of Reference Books:
1. Mathematical Elements for Computer Graphics by: Roger & Adams, Pub: Tata McGraw Hill
2. CAD/CAM Theory & Practice by I. Zeid, Pub: Tata McGraw Hill
3. Computer Graphics (Schaum Series) By: Xiang & Palstock schaums outline series, Tata McGraw Hill

BME 702 MECHANICAL VIBRATION & NOISE ENGINEERING

Teaching Hrs.   **Exam Hrs. – 3**
L-3 T-1 P-0   **Marks: Theory Exam.-80 Term Test – 20 Total 100**

Unit

I. Scope of vibration, important terminology and classification, Degrees of freedom, Harmonic motion; vector representation, complex number representation, addition. Derivation of equation of motion for one dimensional longitudinal, transverse and torsional vibrations without damping using Newton's second law, D' Alembert's principle and Principle of conservation of energy. Compound pendulum and centre of percussion. Damped vibrations of single degree of freedom systems. Viscous damping; under damped, critically damped and over damped systems, Logarithmic decrement. Vibration characteristics of Coulomb damped and Hysteretic damped systems

II. Forced vibrations of single degree of freedom systems. Forced vibration with constant harmonic excitation. Steady state and transient parts. Frequency response curves and phase angle plot. Forced vibration due to excitation of support. Vibration Isolation and transmissibility; Force transmissibility, Motion transmissibility. Forced vibration with rotating and reciprocating unbalance. Materials used in vibration isolation.

III. System with two degrees of freedom; principle mode of vibration, Mode shapes. Undamped forced vibrations of two degrees of freedom system with harmonic excitation. Vibration Absorber; Undamped dynamic vibration absorber and centrifugal pendulum absorber. Many degrees of freedom systems: exact analysis.

IV. Many degrees of freedom systems: approximate methods; Rayleigh's, Dunkerley's, Stodola's and Holzer's methods. Vibrations of continuous systems; Transverse vibration of a string, Longitudinal vibration of a bar, Torsional vibration of a shaft.

V. Sound level and subjective response to sound; Frequency dependent human response to sound, Sound pressure dependent human response. Decibel scale; Decibel addition, subtraction and averaging. Relationship among sound power, sound intensity and sound pressure level. Sound spectra. Octave band analysis. Loudness. Noise: Effects, Ratings and Regulations; Non-auditory effects of noise on people, Auditory Effects of noise, Noise standards and limits in India. Major sources of the noise; Industrial noise sources. Industrial noise control-strategies; Noise control at the source, Noise control along the path, Acoustic barriers, Noise control at the receiver

List of Reference Books:
1. Mechanical Vibrations by G.K.Grover, Nemi Chand & Bros., Roorkee
2. Mechanical Vibrations by V.P. Singh; Dhanpat Rai & Sons, Delhi
3. Vibration & Noise for Engineers by K.K. Pujara; Dhanpat Rai & Sons, Delhi
4. Mechanical Vibrations by J.S. Rao, S. Gupta; New Age International Pub.

BME 703 NON-CONVENTIONAL ENERGY SOURCES

Teaching Hrs.   **Exam Hrs. – 3**
L- 3 T- 0 P-0   **Marks: Theory Exam.-80 Term Test – 20 Total 100**

Unit

I. **Solar Energy:** Solar constant, Solar radiation at Earth's surface, Physical Principles of the conversion of solar radiation into heat, Flat plate collectors, Energy balance equation and collector efficiency , concentrating collector, advantages and disadvantages, water heating, building heating and cooling .Solar thermal electric conversion system, solar Pumping, solar Furnace

II. **Wind Energy**: Basic principles, site selection, WECS (Wind Energy Conversion System): components, classification, advantages and disadvantages. Wind Machines: Types, performance. Generating systems, application, and safety.

III. **Bio Energy**: Conversion technologies, biogas generation, biogas plants, classification, construction of main digesters, materials for bio gas, side selection, advantages, disadvantages and applications.

IV. **Geothermal Energy**: Geothermal fields, sources, hydro thermal resources, liquid dominated systems, hybrid system, advantages, disadvantages, and applications.
Chemical Energy: Fuel cell (Principle of operation of a fuel cell with reference to H_2, O_2 cell), advantages, disadvantages and applications.
Thermionic Generation: Concept, Basic thermionic generator.

V. **OTEC (Ocean Thermal Electric Conversion):** Methods, open cycle and closed cycle OTEC system. Tidal energy: principle, component of tidal power plant, operating methods, energy estimates, site selection. Introduction to MHD, principles and system.

List of Reference Books:
1. Non-conventional Energy Sources by G.D. Rai; Khanna Pub.
2. Non-conventional Energy Sources by D. Chouhan; New Age International Pub.
3. Non-conventional Energy Sources by Rajendra Prasad; Jain Bros.
4. Non-conventional Energy Sources by B.H. Khan; The McGraw Hill

BME 704 OPERATION RESEARCH

Teaching Hrs.   **Exam Hrs. – 3**
L- 3 T-0 P-0   **Marks: Theory Exam.-80 Term Test – 20 Total 100**

Unit
I   **Overview of Operations Research:** Linear Programming: LP formulation, graphical method, simplex method, duality and Sensitivity analysis, Transportation Model, Assignment Model, constrained optimization and Lagrange multipliers.
II   **Replacement Models:** Capital Equipment replacement with time, group replacement of items subjected to total failure, Industrial staff problem, replacement problems under warranty condition.
III   **Queuing Theory:** Analysis of the following queues with poisson pattern of arrival and exponentially distributed service items, Single channel queue with infinite customer population single channel queue with finite customer population, Multichannel queue with in finite customer population & Cost Analysis.
IV   **Simulation:** Need of simulation, advantages and disadvantages of simulation method of simulation. Generation of Random numbers, Generation of normal Random numbers, Generation of random numbers with any given distribution. Use of random numbers for system simulation, Application of simulation for solving queuing Inventory Maintenance, Scheduling and other industrial problems.
V   **Competitive Situations and solutions:** Game theory, two persons zero sum game, approximate solution, Solution of 2xn & mx2 GAMES, Application of LPP. Theory of Decision making: Decision making under certainly and uncertainly, decision trees.

List of Reference Books:
1. Introduction to Operation Research: Hilller f.S. & Liberman G.J., CBS Pub.
2. Operation Research: Taha H.A., McMillan Pub.
3. Foundation of Operation: Heightler,C.S. & Philips D.T. Prentice Hall.
4. Fundamentals of Operational Research: Sasieni, Wiley
5. Operations Research: Ravindra A., Phillips D.T., Solberg J.J., Johnwilley.
6. Quantitative Techniques in Management : ND VOHRA, TMH Pub.
7. Operation Research : Hira & Gupta, S. Chand Pub.
8. Operation Research Theory and Applications : J.K. Sharma, Macmillan

BME 705 REFRIGERATION & AIR CONDITIONING

Teaching Hrs.   **Exam Hrs. – 3**
L- 4 T-1 P-0   **Marks: Theory Exam.-80 Term Test – 20 Total 100**
Unit

I.   **Introduction to Refrigeration and Air Conditioning:** Methods of refrigeration; conventional and nonconventional; Units of refrigeration; C.O.P.
Air Refrigeration: Bell Coleman and Brayton cycles; Simple Bootstrap and other aircraft refrigeration systems

II.   **Vapour compression Refrigeration:** Carnot vapour compression cycle; Simple vapour compression cycle. Effect of sub cooling, superheating and pressure on cycle performance; Actual vapour compression cycle; Multistage compression and cascade refrigeration cycles.
Refrigerants; Desirable properties of refrigerants: Primary and Secondary refrigerants: nomenclature, various refrigerants and their properties; Alternatives of the chlorofluorohydrocarbons.

III.	**Vapour absorption Refrigeration :** Working Principles ; COP comparison with vapour compression Refrigeration systems; Actual aqua ammonia vapour refrigeration system; Lithium Bromide water absorption system; Electrolux refrigeration system, Application of absorption refrigeration system, system based on waste heat utilization.
IV.	**Other Refrigeration System:** Principle and application of steam jet refrigeration system, Performance ; vortex tube refrigeration, thermoelectric refrigeration systems. **Air Conditioning:** Psychrometry, Psychometric relations, psychometric chart and various processes, Apparatus dew point, by pas and contact factors. Human comfort. Factor affecting human comfort, comfort chart. **Cooling and Heating Load Calculation :** Design condition; Sensible and latent heat loads : Sensible heat ratio; Structural, electrical, infiltration and ventilations heat gains ; Occupancy heat gains; Heating & Cooling load estimates, winter and summer design condition, air quantity and temperature requirement. Unitary and central air-conditioning system; Summer, winter and all year air-conditioning, Air washers.
V.	**Air Conditioning Systems & Air Distribution:** Distribution of air in conditioned space outlet location, return and exhaust grills. Duct materials and sizing, design of supply and return air ducts. **Solar radiation:** Direct & Diffuse radiations, Sun earth angles direct solar radiation on vertical horizontal & inclined surface empirical methods to evaluate heat transfer through walls and roofs.

List of Reference Books:

1. Refrigeration and Air Conditioning, C.P. Arora ; Tata Mc Graw-Hill Pub. Co. Ltd.
2. Refrigeration and Air Conditioning, Manohar Prasad , New Age International Pub.
3. Refrigeration and Air Conditioning, P.L. Ballaney, Khanna
4. Refrigeration and Air Conditioning, R.C. Arora, PHI

(Electives)

BME 706.1 ENVIRONMENTAL SCIENCE

Teaching Hrs.   **Exam Hrs. – 3**
L-3 T-0-P-0   **Marks: Theory Exam.-80 Term Test – 20 Total 100**

I. Sustainable, sound and Holistic development, Hydrological and other cycles, Nutrient cycles, Carbon, Nitrogen, Sulphur and Phosphorous cycles.
II. Energy flow. Solar insolation. Basics of Species, Community, Niche, Habitable and Ecosystems. Biodiversity, Population dynamics, Malthusian logistic curve. Material Balance. Energy fundamentals.
III. Environmental Impact assessment of conventional and Non-conventional energy projects. Prediction Technologies. Air and Water pollution. Emission Standards.
IV. Greenhouse effect. Global warning. Ozone depletion. Acid rain etc. Instrumental of techniquesin detection of pollutants. Spectroscopy- chromatography and potentiometry.
V. Causes of Environmental problems. Environmental policies and legislation. Pollution controlstrategies. Hazardous waste and risk analysis.

List of Reference Books:
1. Introduction to Environmental Engineering and Science, Gilbert M. Masters, Prentice Hall of India, 1995
2. Concept of Ecology, Edward J. Kormondy, 1991
3. Ecology, Odum, 1975
4. Environmental Impacts Assessment, Canter L., McGraw Hill, New York.1977

BME 706.2 OPTIMIZATION METHODS (Elective)

Teaching Hrs.   **Exam Hrs. – 3**
L-3 T-1 P-0   **Marks: Theory Exam.-80 Term Test – 20 Total 100**

I. **Introduction:** Historical development, engineering application of optimization, Formulation of design problems as mathematical programming problems, Classification of optimization problems.
II. **Linear Programming:** Simplex methods, Revised simplex method, Duality in linear Programming, post optimality analysis.

III.   **Application of Linear Programming**:   Transportation   and   assignment
        problems.

IV.   **Non Linear Programming:** Unconstrained optimization techniques, Direct search methods,
        Descent methods, Constrained optimization, Direct and indirect methods.
V.   **Dynamic Programming:** Introduction, multi-decision processes, computational procedure.

List of Reference Books:
1. "Linear Programming". G. Haddley
2. "Optimization methods for engineering Design". RL. fox Addison Wesley, USA.
3. "Mathematical Programming Technique". N.S. Kambo
4. "Optimization Theory and Application", S.S. Rao,Wiley Eastren, New Delhi

BME 706.3 ENTREPRENEURSHIP DEVELOPMENT

Teaching Hrs.   **Exam Hrs. – 3**
L-3 T-0-P-0   **Marks: Theory Exam.-80 Term Test – 20 Total 100**

I.   **Entrepreneurship:** Need scope and characteristics nature of entrepreneurship ventures in
        India economic and industrial heritage and entrepreneurship development; current economic
        and industrial environment with special reference to entrepreneurial ventures and economic
        growth. Understanding Human Behavior time management, group dynamics, conflict and
        stress management

II.   **Small**, medium and large industrial sectors, Industrial potential and identification of
        opportunities, demand and resource based industries, service sector, corporate
        entrepreneurship, entrepreneurship and technocrat entrepreneurship

III.   **SSI:** definition and legal frame planning for small enterprise; major policies, organization of
        SSI units, reservation of items for SSI units, role of SIDO, NSIC and SSI corporate.
        Marketing and Price distribution Methods of sales promotion state and central government
        purchase procedures: promotional and advertising methods, marketing research policies &
        Strategies, price determinate expert policies Financing of small scale industries, tax
        concession to SSI units. Machinery on Hire Purchases, Controlled & Scarce Raw Materials.

IV.   **Production Planning:** Elements of production process managing production life cycle,
        PERT, CPM; managing production support services, product licensing, patenting;
        certification agencies, ISO 9000, and 14000, CS 8000 series;

V.   **Testing facilities,** Quality Control. Project identification, decision making area money,
        market, machinery and material; Project planning and executing; working capital
        management sources and uses of funds; ration analysis; break even analysis, cost control;
        time control; Evaluation and preparation of project report.

List of Reference Books:
1. Organization & Management of small Scale Industries: Desai. J.V. Himalaya. Bombay. 1985
2. Management of Small scale Industry: 3rd Himalaya. Bombay.1986
3. The Story of an Entrepreneur: M. Nath. IMT Monographs
4. Small Industry Monographs Handbook: Mohan. K.K. Bombay Productivity Services International
5. Handbook of Entrepreneurship: Rao & Pareek New Delhi: Learning System.1978

BME 706.4 WELDING TECHNOLGY

Teaching Hrs.   **Exam Hrs. – 3**

L-3 T-0 P-0   **Marks: Theory Exam.-80 Term Test – 20 Total 100**

I.   **Introduction :** AWS Definition of welding; **Classification of Welding Process:** Fusion
        welding; Resistance welding; Solid state welding and Modern methods of welding;
        Design of welded Joints: Types of weld joints; types of weld groove and their symbols;
        Definition of welding terms: crater; weld bead; fillet weld; Penetration; Root of weld; Tack-
        weld; Toe of weld; **Welding position**s : Flat, Horizontal, Vertical and Overhead.

II. **Welding Processes:** oxyacetylene gas welding, equipments and flames, advantages, disadvantage & application; Other combination of gasses which can be used; Definition to Autogenous, Homogeneous and Heterogeneous welding. Principle of arc welding, equipments, advantages, disadvantage & application; Comparison of AC & DC power source, Comparison between DCSP & DCRP, Phenomenon of arc below. **Welding Electrode:** Classification of welding electros, Coating materials of coated electrodes & their functions; Specification of electrodes as per AWS, Methods of arc initiation; Mechanism of metal transfer in arc welding.

III. **Resistance, Solid State & Modern Methods of Welding :** Principle of resistance welding; Methods of resistance welding & their application; **Solid State Welding:** Frication welding, Diffusion welding; Cold pressure welding & their application; **Modern Methods of welding:** CO_2- MIG welding, TIG welding, Electron Beam welding; Laser beam welding; Plasma arc welding; Ultra sonic welding, Explosive welding & under water welding.

IV. **Welding Metallurgy & Allied Welding Process:** Weldability, factors effecting weldability, Heat affected zone (HAZ); Width of HAZ; Micro Structure changes occurring in HAZ; Peak temperature; Cooling rates Residual stresses in welding & their measurement.
Allied Welding Process: Thermal cutting processes: Oxy-acetylene cutting, Laser cutting, Metal Cladding, Metal spraying, Welding of pressure vessels & Reactor metals

V. **Welding Defects:** Incomplete Penetration, Lack of fusion, undercutting, overlap, slag Inclusion Porosity, Hot Cracks, Cold Cracks, Crater Crack, Spatter, their cause & remedies, Hydrogen embattlement; Determination of hydrogen dissolved in weld metal.

List of Reference Books:
1. Modern Arc Welding Technology   S.V.Nadkar Pub. Advani- Oerlikon ltd.
2. Welding Technology, R.S. Parmar, Khanna Publishers. of products.
3. Welding & Welding Technology, Richard L. Little.
4. Welding Technology by V.M. Radha Krishnan.
5. Introduction to Manufacturing Technology by P. N. Rao, McGraw Hill
6. Welding Handbook, American Welding Society.
7. Processes and materials of manufacturing, Roy-A. Lindberg.
8. Welding Technology – O.P. Khanna

BME 706.5 PLASTICITY AND METAL WORKING

Teaching Hrs.   **Exam Hrs. – 3**
L-3 T-0 P-0   **Marks: Theory Exam.-80 Term Test – 20 Total 100**

1. **Introduction** to plasticity, stress strain tensors and their invariants. spherical, deviator and octahedral stresses, Yield conditions. Plastic Stress-strain relations, Plastic conditions. Slip line field theory and upper bound analysis, concept of lubrication in metal working. Calculation of loads in plane-strain compression (slab method).

2. **Theory** of Rolling: Determination of rolling loads and torque. Design of rolls, camber, Design of grooves for rolling various sections, strip rolling. Influence of rolling techniques and properties of products.

3. **Analysis** of Various metal Working Processes: Theoretical basis of metal forming, classification of metal forming processes, cold working, hot working, warm working or semi hot working, Effects of variables on metal forming processes, flow through conical converging dies, upper bound and free body equilibrium approach, optimal cone angle and dead zone formation.

4. **Analysis** of metal working processes like extrusion, deep drawing and wire drawing. Analysis of closed and open die forging processes and pressing, forging of Solid and hollow disks, slow and high speed forgings.

5. **Introduction** to stretch forming, bending and spinning. Sheet metal working, blanking, piercing, deep drawing, forming

List of Reference Books:
1. An Introduction to the Principles of Metal Working. Rowe,Arnol
2. Metal Formatting Analysis. Avitzur. McGraw Hill.
3. Plasticity for Mechanical Engineers. Johnson & Mellore. Van Nostrand
4. Mechanical Metallurgy. George Dieter. McGraw Hill.
5. Plasticity, Chakravarty.

BME 706.6 FINANCIAL MANAGEMENT

Teaching Hrs.   Exam Hrs. – 3
L-3 T-0-P-0   Marks: Theory Exam.-80 Term Test – 20 Total 100

1. **Management Accounting:** Concept, objects, functions and its nature, Financial Accounting V/s Management Accounting, Modification of financial data of serve managerial needs, scope of management Accounting, Conventions of Management Accounting.
2. **Financial planning:** Need for financial planning, objects of financial plan, factors, limitations, financial guide lines.
   Concept of working Capital: Kind, nature, Significance of working capital and working capital Financing
   Long term Financing: Sources, Uses, Limitations, Comparative Analysis.
3. **Financial statements:** Basic concepts underlying financial accounting, Balance sheet, Profit & Loss Account, Sources & uses of funds statement Working capital, Cash & Total resources Basis.
4. **Financial analysis:** Ratio analysis -Types of Ratio, Liquidity Ratios, Capital Structure Ratios, Profitable Ratios, Turnover Ratios: Time series Analysis, Index analysis, Comparative common size analysis.
5. **Analysis of Leverage:** Types of Leverage, Financial Leverage, Operating Leverage & combined Leverage.
   Financial control: Concept and Nature. Aims and Techniques. Characteristics of a sound system of financial control.

  List of Reference Books:
 1. Financial Management- Principles and Practices, I.M. Pandey, Vikas Publishing House.
 2. Management Accounting Financial Management & Holding Company Accounts,
  Nagarathnam S., S. Chand & Company.

IV B. TECH. VIII SEMESTER
BME 801 COMPUTER AIDED MANUFACTURING

Teaching Hrs.   Exam Hrs. – 3
L- 4 T-0 P-0   Marks: Theory Exam.-80 Term Test – 20 Total 100

I Introduction: Overview of manufacturing processes, types of manufacturing systems, the product cycle, computer's role in manufacturing, sources and types of data used in manufacturing. The Beginning of CAM: Historical Background, Basic components of NC systems, NC Procedure, NC coordinate system and machine motions, applications and economics of NC.

II Part programming- manual and computer assisted such as APT Language. Computer Controls In NC Systems: Problems with conventional NC computer numerical control, direct numerical control, combined CNC/ DNC systems, adaptive control machining system computer process interfacing, New development and latest trends.

III Computer Aided Process Planning: Traditional Process Planning, Retrieval process planning system, Generative Process Planning, Machinability data system, Introduction to AGV, Manufacturing Resource Planning (MRP-II),

IV Group Technology: Introduction to GT, GT cell and flow lines, different part coding systems part print analysis, optiz's and multi-class coding, implementation of GT. Collaborative Engineering : Introduction, Faster Design throughput, web base design, Changing design approaches, extended enterprises.

V Robot Technology: Introduction, Industrial Robot, Robot physical configuration, Basic robot motions, technical features such as work volume, precision, speed, weight carrying capacity of robot, drive systems, programming of robot. Introduction to robot languages, End effectors, interlocks and work cell control, robotic sensors, applications & economics of robot, interfacing of vision system with a robot, Intelligent robot

List of Reference Books:
1. Automation Product Systems & CIM By: M.P. Groover, Pub: PHI
2. NC part programming by: Kundra, Rao , Tiwari, THM publication.
3. CAD/CAM Theory & Practice by I. Zeid, Pub: Tata McGraw Hill

BME 802 POWER PLANT ENGINEERING

Teaching Hrs.   **Exam Hrs. – 3**
L- 4 T- 0 P-0   **Marks: Theory Exam.-80 Term Test – 20 Total 100**

I. **Steam Power Plant:** Lay out and site selection for steam power plants Steam Generation: High pressure and super critical boilers; circulation of water in high pressure boilers; natural and forced circulation; Advantages and disadvantages; water walls; directly & indirectly heated boilers; Lamont, Benson, Loeffler, velox boilers. Draught System; Losses in air gas loop system and its measurement; natural forced, induced and balanced draught

II. **Fuel Storage and handling:** Coal handling for thermal power plants; coal feeding and burning methods; pulverized fuel firing & FBC. Ash handling and Dust Collection; Disposal of ash and dust.

   Cooling Towers: Necessity of cooling condenser water; Water cooling methods; Types of cooling towers: Hyperbolic, Atmospheric, Induced draft & Forced draft cooling towers; Indirect and Direct dry type cooling systems water distribution in cooling towers

III. **Nuclear Power Plants**: Elementary concept of physics of generation of nuclear energy, Nuclear materials and waste disposal; nuclear fuels, fuel cycles, coolants, moderating and reflecting materials; cladding materials, shielding materials; Disposal of nuclear waste; General components of nuclear reactor, different types of nuclear reactors, Their construction and working; Location of nuclear power plants; Comparison of nuclear plants with thermal plants. Enrichment; safety and control. Fast breeder reactors and power plants

IV. **Hydro-electric power Plant**: Classification and applications of Hydro-electric plant; Measurement of stream flow; capacity calculation of hydro-power, The hydro plant and its auxiliaries; automatic and remove control of hydro-systems.

   Power Plant Economics: Load curves; different terms and definitions; cost of electrical energy; Selection of plant for economical generation; Performance and operating characteristics of power plants; load division combined operation of power plants; load division between stations. Different systems of tariff.

V. **Diesel and Gas Turbine Power Plants**: General layout; elements of diesel power plants; field of use; systems of diesel power plant; comparison with steam power plants (advantages and disadvantages). General layout of gas turbine plants; plant components; different arrangements for plant components; governing system, combined gas and steam power plants; Advantage of combined cycle, Advantage and disadvantage over diesel and steam plants. Introduction to integrated coal gasification combined cycle power plants

   Pollution and its control: Air and water pollution & control, water pollution by thermal plants and its control, Acid Rains, Thermal Pollution by Thermal and Nuclear Power Plants, Noise Pollution and Noise Control.

List of Reference Books:
1. Power Plant Engineering by P.K. Nag; Tata McGraw-Hill.
2. A Course in power Plant Engineering, by Arora and Domkundwar Dhanpat Rai.
3. Power Plant Engineering, by Black and Veatch, CBS publication.

BME 803 OPERATIONS MANAGEMENT

Teaching Hrs.   **Exam Hrs. – 3**
L- 4 T-0 P-0   **Marks: Theory Exam.-80 Term Test – 20 Total 100**

Unit

1. **Operations Management:** An Overview - Systems concepts in Operations Management, Objectives in Operations Management, Operations management Decisions.

   Forecasting Demand: Forecasting, Objectives and uses, Qualitative & Quantitative methods of Forecasting, Opinion and Judgmental Methods, Time Series Methods, Exponential Smoothing, Regression and Correlation Methods, Application and Control of Forecasting.

2. **Production Planning and Control (PPC):** Types of production, Functions and elements of production planning and control, Routing, Scheduling, Dispatching Expediting and Control with other departments. Introduction to CPM and PERT.

   Capacity Planning: Capacity Strategy, aspects of Capacity Planning, Determination of Capacity Requirement, Types of capacity, Capacity Control, Evaluation of Alternative plant size, Traditional Economic Analysis, Cost-Volume Profit Analysis. Aggregate planning and master scheduling,

Objectives of Aggregate planning Methods, Master Scheduling, Objectives, Master Scheduling Methods.

3. **Materials Management:** Field and scope of material management, material planning and program, Types of Inventories, Economic lot size, lead time and re-order point, Deterministic Inventory Models. Procedure for purchase and storage, ABC Analysis.

   Just in Time (JIT) in manufacturing planning & control. Major-elements, Characteristics of Just in Time System pre-requisite for JIT manufacturing, Elements of Manufacturing, Eliminating Waste, Enforced, Problem Solving and Continuous Improvements, Benefits of JIT Purchasing, The Kanban System JIT, Implementation in Industries.

4. **Job Evaluation and Merit Ratings:** Objectives of job evaluation, Methods of job evaluation- Quantitative and non-quantitative. Concept of Merit Rating.

   Wages and incentives: Characteristics of a good wage or incentive system, Methods of wage payment, Concept of wage, time wages, piece wages system, incentive schemes.

   Product Development: Issues in choosing manufacturing technologies and strategies: product life cycle, standardization, simplification, and diversification.

   Value Analysis and Value Engineering: Introduction, Concept, Definition, Procedure and Advantages.

5. **Industrial Relations**: Management-Union relations, Trade Union movement, Industrial Disputes and methods of settling disputes (i) Collective bargaining (ii) Conciliation (iii) Mediation (iv) Arbitration Employee's participation in Management.

   Labour Legislation: Indian Factory Act, Payment of wages Act, Workman's Compensation Act, Trade Union Act, Industrial Dispute Act, Employees State Insurance Act, Minimum Wages Act.

List of Reference Books:
1. Production and Operations Management by Everette E. Adam, Jr. and Ronald J. Ebert
2. Industrial Engineering & Production Management by M.Mahajan. Dhanpat Rai
3. Industrial Engineering & Management by O.P. Khanna. Dhanpat Rai
4. A text book of Production Engineering by P. C. Sharma. S. Chand

(Electives)
BME 804.1 FACILITIES PLANNING AND MATERIAL HANDLING

Teaching Hrs.   **Exam Hrs. – 3**
L-4 T-0 P-0   Marks: Theory Exam.-80 Term Test – 20 Total 100

FACILITIES PLANNING

I. **Plant Location:**
   Introduction: The ideal location. Proximity to market. Proximity to raw materials, Transportation costs. The Labour supply. electric power. Water and land costs. Local Taxes. Security from attack. Specialized communities, Climate, Urban, Suburban, and small town locations, Plant location trends, Best location for small plants. Incentive offered by State Government for dispersal of industries. Planned Industrial centers Government industrial estate - public sector plants and their location, growing competition for industry among states to locate in their midst. centralization v/s decentralization - decentralization by horizontal and vertical methods. sources of information concerning location. Moving to a new location. Moving costs. To lease or buy or build an industrial plant.

II. **Plant Location techniques & Plant Layout:** Euclidean distance, squared Euclidean distance, rectilinear distance, linear distance methods, Problems on multi-location.
   Plant Layout:
   Introduction to plant design, types of manufacturing processes. Plant location, influence of location on layout, Industrial Buildings. Influences of Building on Layout, Classical types of layout product layout and Process layout and practical layouts.
   Planning the Layout: Various operational Research techniques for balancing of assembly lines, Fabrication line balancing.

III. **Material Handling:** Types of materials handled in an engineering plant, basic principles of material handling. Engineering and economic factors. Classifications of material handling equipment's according to operating principle, construction and nature of service.
   Safety Engineering; Safety in Machine shop, forging shop, carpentry shop, welding shop and foundry shop. Safety in critical storage area. Storing explosive materials, gases and inflammable liquids. Organizational and selection of material handling system. Operation, maintenance, and safety precaution Selection of plant layout from material handling criteria

IV. **Gravity Equipment's** - Chutes, belt and rolling conveyers. Gravity roller spirit's Fixed systems of power driven conveyers, Belt, chain slot, apron, wire brush, Pellet, roller flight, cross bar and chain trolley type of conveyers, Arm, vertical Belt and suspended tray type of Elevators, reciprocation elevators industrial elevators, screw conveyers, ribbon conveyers, bucket elevators, etc. Skip hoists, drag scrapers, tramways and cableways Pneumatics and hydraulic conveyers.

V. **Cranes** ; jib electric overhead traveling (E.O.T.), cantilever cranes. Track systems; Overhead track of monorail system. Industrial railways, locomotive cranes. Portable conveyers; Hand trucks, Forklift trucks. Container system of transport; Unit loads, standardization of unit load handling Co-ordination of handling with production; continuous, repetitive and intermittent type. Application of time and motion study.

List of Reference Books:

1. Practical Plant Layout, Muther, McGrawHill
2. Plant Layout & Design, Immer, McGrawHilll
3. Material Handling, Immer, McGrawHill
4. Facilities Planning, Tomphins James A & White John Wiley & Sons.
5. Facility Layout & Location, Francis R.C. & White J.A. Prentice Hall

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BME 804.2 DESIGN FOR FATIGUE AND FRACTURE

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Teaching Hrs.   **Exam Hrs. – 3**
L-4- T-0-P-0   **Marks: Theory Exam.-80 Term Test – 20 Total 100**

Unit

I. **Introduction:** Micro - mechanics of Brittle and Ductile Fracture, Modes of Fracture Failure.
   Energy Release Rate: Griffith's Energy approach, Mathematical formulation of energy release rate, change in compliance and change in strain energy approach, energy release rate of DCB specimen, Inelastic. Deformation at crack, Crack resistance, Stable and unstable crack growth, R-curve for Brittle cracks. Thin Plate v/s thick plate, Critical Energy release rate.

II. **Linear Elastic Fracture Mechanics (LEFM):** Strain and Displacement Field at Crack tip and Stress intensity factor (SIF) for few cases. Application of the Principle of superposition. SIF of edge cracks and embedded cracks. Relation between G and K. critical stress intensity factor Deformation at the Crack-Tip: Approximate shape and size of the plastic zone. Effective crack length: few approaches. Effect of plate thickness, plane stress v/s plane strain, crack opening displaced (COD), CTOD, relation between CTOD. Ki and Gi.

III. **Elastic-Plastic Analysis:** J-integral and its path independence. Critical J- integral. Application of J-integral to practical problems. Equivalence between CTOD and J.

IV. **Fatigue Failure:** Crack initiation, Crack Propagation, Paris and Erdogan Law, Factors affecting crack propagation, Variable Amplitude Fatigue load. Fatigue damage: Design for used materials, Minors, Mansons and Other theories Random fatigue. Use of Minor's theory.

V. **Fracture Control Plans:** Various Fracture Control Plans, Effect of flaw size, Temperature and Kid on Crack growth.

List of Reference Books:

1. Elements of Fracture Mechanics, Kumar Prashant, Wheeler Publishing
2. Elementary Engineering Fracture Mechanics, Broek David, Martinus Nighoff Publishers
3. Application of Fracture Mechanics, Fracture and Fatigue in Structures Rolfe and Barson, PH.

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BME 804.3 MACHINE TOOL DESIGN

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Teaching Hrs.   **Exam Hrs. – 3**
L-4 T-0 P-0   **Marks: Theory Exam.-80 Term Test – 20 Total 100**

1. **Introduction to Machine tool Design and Mechanisms:** Working and Auxiliary motions in Machine tool parameters defining the working motion of a machine tool, machine tool devices, hydraulic transmission and its elements. General requirements of machine tool design

2. **Regulation of speed and Feed Rates:** Aim of speed and feed rate regulation, stepped regulation of speed; Design of speed box; structural diagrams, general conditions for developing the gearing diagram steeples regulation of speed and feed rates.

3. **Design of Machine tool structure:** Functions of Machine tool structures and their requirements. Design criteria for machine tool structures, materials of Machines tool structures, static and

dynamic, structure profiles of machine tool   structures. Basic design procedure fro machine tool structure.

4. **Design of Spindles:** Functions of spindle unit and Requirements, Materials of spindles, Design Calculations of spindles

5. **Dynamics of Machine Tools:** Dynamic characteristics of elements and systems, Dynamic characteristics of Equivalent Elastic system. Dynamic characteristics of the cutting process, Stability analysis.

List of Reference Books:

1. Machine tool Design, N.K. Methta, Tata McGraw Hill
2. Design of Machine Tools, S.K. Basu & D.K. Pal, Oxford & IBH Publishing Co.
3. Machine Tool Design, G.C. Sen and A. Bhattacharya.

BME 804.4 FINITE ELEMENT ANALYSIS

Teaching Hrs.   **Exam Hrs. – 3**
L-4 T-0 P-0   **Marks: Theory Exam.-80 Term Test – 20 Total 100**

1. **Stress** strain and deformation relations , plane - stress, planes strain, Principles of minimum Potential Energy, principle of virtual work.
2. **Stiffness** method for steady state problems of discrete systems (Bar, trusses, one dimensional heat transfer system) Element stiffness matrix, Assembly of elements, global stiffness matrix and its properties, Node numbering, Displacement and force Boundary conditions, Transformations matrix, Gauss elimination method.
3. **Displacement** - Based FEM for solid mechanics; Derivation of finite element equilibrium equations, Langrangian elements (I-D & 2- Delements); CST, rectangle, aspect ratio shape functions, lumping of loads, compatibility and convergence requirements. Stress calculations Isopohmetric Derivation of Stiffness matrices, bar and plane bilinear elements, Seredipity elements, natural coordinates, numerical integration, Co-continuity p and h refinement
4. **Variational Method:** Variational Approach for known functional of field problems
    Weighted Reidual Methods: Point collection, subdomain collocation, methods of least
    square,Galerkin Application of these methods to one dimensional boundary value problems; Structures, fluid mechanics and heat transfer.
5. **Finite** Elements in Dynamics and Vibrations: Introduction, Dynamic Equations, Mass and Damping Matrics, Mass Matrics, Consistent and Diagonal, Damping, Natural frequencies and Mode Shapes.

   List of Reference Books:

1. Introduction to Finite Elements in Engineering, Tirupathi R. Chandrapatla and Ashok D.   Belegundu, Prentice Hall of India. Ltd.
2. Concepts and applications of Finite Element Analysis, Robert D. Cook, David S.Malkus,   Michaiel E. Palesha, John Wiley & Sons.
3. Finite element Procedures, Klaus Jurgan Bathe, Prentice Hall of India.New Delhi

BME 804.5 MECHATRONICS

Teaching Hrs.   **Exam Hrs. – 3**
L-4 T-0 P-0   **Marks: Theory Exam.-80 Term Test – 20 Total 100**

1. Definitions of mechatronics design process, introduction to mechatronics systems and components.
2. Principles of basic electronics. Microprocessors and their applications, integrated circuits, sensors, actuators and other electrical/electronic hardware in mechatronic systems.
3. Principles of electronic/system communication. Interfacing, DA and AD convertors, Software and Hardware principles and tools to build mechatronic systems. System models .
4. Selection of mechatronic elements namely sensors like encoders and resolvers, stepper and servomotors, ball screws, solenoids, like actuators and controllers with applications to GNC systems, robotics, consumer, electronic products etc.
5. Business drivers for mechatronics, organizational structure for mechatronics, implementing a mechatronic design process.

List of Reference Books:
1. Mechatronics Engineering: Tomkinson, D. and Horne, J.,Tata McGraw Hill.
2. Mechatronics: Bolton W., 1995.
3. Mechatronics: JMT Hand Book, 1998.
4. Understanding Electro-Mechanical Engineering, Kamm, L.J., IEEE Press, New York, 2000.

BME 804.6 ENGINEERING ETHICS & LEADERSHIP

Teaching Hrs.   **Exam Hrs. – 3**
L-4 T-0 P-0   **Marks: Theory Exam.-80 Term Test – 20 Total 100**

1. **Ethics & Morality:** Meaning, Nature & Scope of Ethical Value system, ethical values and professional obligations, Technology & Human Values Emergence of utilitarian ethics- Benthan and Mull, Sanctions of Morality, Righteous thinking, trends & forces of evolutionary ethics - Darwin's theory of natural screen.
2. **Organization Behavior & Engg. Ethics:** Ethical issues forced by Manufacturing and service organizations, congruency between corporate objectives and industrial goals, safety engineering. Psychological Ethics & Ethical behavior: Human Side of Engineering: elements of general psychology - heredity & environment, Emotion and Modulation Perception, Learning etc. Basis of Human Behavior, Job related issues, job performance & interviews, loading monitoring & supervising
3. **Ethics & Quality Issues:** Quality Principles and Practices, Role of Quality stands and marketing demands, intellectual property rights, Patent Acts.
   Communication & Ethics: Using Communication Media for Vocational purposes,
   Communicative Principles, methods of modulation & demodulation, Neuro – linguistic Programming (NLP) Simulation & Role Playing, psychological Barriers to communication. Basic structure of Value Theory, theory of normatively in Human action & communication media
4. **Leadership:** Meaning of Leadership, theories of leadership, Behavioral theories, Situational theories, Patti Goal theory of leadership, team building
   Leadership Decision Making: Leadership decision theory, Values & alternatives, Decision making models, integrated leadership model
   Leadership styles: Motivational style, power style Orientation style, Leadership model Fiedler's contingency model Likert's system of leadership, ethical and environmental management and society, value system & philosophy
5. **Group Dynamics:** Concept & Features of Group dynamics, stages of group development, group behavior, group cohesion, group decision making, case studies of personality making case studies of personality and group dynamics, current developments

List of Reference Books:
1. Engineering Ethics – Concepts, Viewpoints, Cases and Codes, Bill Baker at el.