UNIVERSITY OF CALICUT

FACULTY OF ENGINEERING

Curricula, Scheme of Examinations & Syllabi for Semesters 3 to 8 of B Tech. Degree Programme in Mechanical Engineering with effect from Academic Year 2004-2005

THIRD SEMESTER

Code	Subject	Hours/Week			Sessional Marks	University Examination	
		L	T	P/D		Hrs	Marks
ME04 301	Engineering Mathematics III	3	1	-	50	3	100
ME04 302	Computer Programming	3	1	-	50	3	100
ME04 303	Fluid Mechanics	3	1	-	50	3	100
ME04 304	Mechanics of Solids	3	1	-	50	3	100
ME04 305	Machine Drawing	1	-	3	50	3	100
ME04 306	Electrical Tecnology	3	1	-	50	3	100
ME04307(P)	Electrical Technology Lab	-	-	3	50	3	100
ME04 308(P)	Materials Testing Lab	-	-	3	50	3	100
TOTAL		16	5	9	400	-	800

UNIVERSITY OF CALICUT

Faculty of Engineering

Syllabi for B.Tech Degree Programme with effect from Academic Year 2004-2005

ME04 Engineering Mathematics III

To be prepared

ME : Mechanical Engineering

ME04 302 :COMPUTER PROGRAMMING (Common to all Branches)

To be prepared

(3hours lecture&1hour tutorial per week)

ME04 303 : FLUID MECHANICS

3 hours lecture and 1 hour tutorial per week

Module I

Fundamentals Concepts : Characteristics of fluids – continuum – properties of fluids – density, specific weight, specific volumes, specific gravity, viscosity, capillarity, compressibility, surface tension, vapour pressure.

Fluid Statics : Pressure – variation of pressure in static fluids – absolute and gauge pressures – measurement of high and low pressures – manometers – forces on bodies and surfaces submerged in fluids – stability of bodies submerged and floating in fluids – metacentric height.

Module II

System and control volume approach - basic equations – Reynold's transport equations – differential and integral form of continuity , momentum and energy equations – application of the above equations for one dimensional flow – velocity and momentum corrections - one dimensional flow along streamline and stream tubes - Euler's equation - Bernoulli's equation – applications - Venturimeter, Orificemeter, Pitot tube, Orifice , Mouthpiece, Notches and weirs.

Module III

Fluid Kinematics – Eulerian and Lagrangian flow descriptions – classification of fluid flow – graphical description of flow pattern – stream lines , path lines, streak lines, stream tubes – velocity and acceleration in fluid flow.

Ideal fluids – rotational and irrotational flow – circulation and vorticity – stream function and potential function – basic flow fields – rectilinear flow - source and sink . Flow through pipes – Reynold's experiment - laminar and turbulent flow – critical Reynold's number – laminar flow in circular pipes – Haygen - Poiscille law – turbulent flows in circular pipes – Darcey - Weisbach equations – Eddy properties – Minor losses in pipes – total head - pressure lines .

Module IV

Boundary layer – Introduction –boundary layer over flat plate – continuity and momentum equations for laminar boundary layer – boundary layer thickness – velocity profile – integral solutions of momentum equations – boundary layer on immersed bodies – drag and lift – skin friction – boundary layer separation

Introduction to turbulance, classification, scales of turbulance - Reynold's stresses- turbulance models- Prandtl mixing length concept.

Text Books

Douglas, Fluid Mechanics, Pearson Education

D S Kumar, Fluid Mechanics, S K Kataria & Sons

Reference books

White F M, Fluid Mechanics, 5th Edition, McGraw Hill

Shames I H, Fluid Mechanics,4th Edition, McGraw Hill

S K Som & G Biswas, Fluid Mechanics, Tata McGraw Hill

Fox,Introduction to Fluid Mechanics, Eastern Wiley.

D Ramadingeih, Fluid Mechanics, New Age International

Sessional work assessment

Two Tests = 30

Two Assignments = 20

Total marks = 50

University examination pattern

Q I - 8 short type questions of 5 marks each, 2 from each module

Q II - 2 questions A and B of 15marks each from module I with choice to answer any one

Q III - 2 questions A and B of 15marks each from module II with choice to answer any one

Q IV - 2 questions A and B of 15marks each from module III with choice to answer any one

Q V - 2 questions A and B of 15marks each from module IV with choice to answer any one

ME04 304 :MECHANICS OF SOLIDS
(3hours lecture&1hour tutorial per week)

MODULE I (13 hours)
Introduction-General concepts-Definition of stress-Stress tensor-Stress analysis of axially loaded members-Strength design of members-Axial strains and deformations in bars-Stress-strain relationships-Poisson's ratio-Thermal strain-Saint Venant's principle-Elastic strain energy for uniaxial stress-Statically indeterminate systems-Strain tensor-Generalised Hooke's law for isotropic materials-Relationships between elastic constants-Introduction to anisotropy-Orthotropy.

MODULE II (13 hours)
Torsion-Torsion of circular elastic bars-Statistically indeterminate problems-Torsion of inelastic circular bars-Axial force, shear force and bending moment-Diagramatic conventions for supports and loading, axial force, shear force and bending moment diagrams- shear force and bending moment diagrams by integration and by singularity functions.

MODULE III (13 hours)
Bending stresses in beams-Shear flow-Shearing stress formulae for beams-Inelastic bending of beams-Deflection of beams-Direction integration method-Singularity functions-Superposition techniques-Moment area method-conjugate beam ideas-Elementray treatment of statically indeterminate beams-Fixed and continuous beams.

MODULE IV (13 hours)
Transformation of stress and strains (two-dimensional case only)-Equations of transformation-Principal stresses-Mohr's circles of stress and strain-Strain Roseettes-Compound stresses-Superposition and its limitations-Eccentrically loaded members-Columns-Theory of columns-Buckling theory-Eulers formula-Effect of end conditions-Eccentric loads and secant formula.

Text Book

1. Popov E P.,Engineering Mechanics of Solids,Printice Hall of India

References

1. Timoshenko S.P&Young D.H.,Elements of strength of materials,McGrawhill
2. Shames I.H.,Introduction to solid Mechanics,Prentice Hall of India
3. Beer F.P.&JohnsonE.R,Mecanics of Materials,McGraw Hill
2.

Sessional work assessment
Two Tests = 30
Two Assignments = 20 (Assignments should contain some problems which are computer based)
Total marks = 50

University examination pattern

Part A

Q I - 8 short type questions of 5 marks each, 2 from each module. Minimum 60 % of the questions should be Numerical

Part B

Minimum 90 % of the questions should be Numerical

Q II - 2 questions A and B of 15marks each from module I with choice to answer any one
Q III - 2 questions A and B of 15marks each from module II with choice to answer any one
Q IV - 2 questions A and B of 15marks each from module III with choice to answer any one
Q V - 2 questions A and B of 15marks each from module IV with choice to answer any one

ME04 305 MACHINE DRAWING

3 hours Drawing Practice & 1 hour Lecture per week

Module-0 (8 hours - 2 drawing exercises)

a) **Introduction to Machine Drawing**- Principle of multi-view projection applied to machine drawing. The six-plane views in first angle projection. Conversion of pictorial views of simple machine elements to orthographic views. Rules of sectioning and conventions. Types of sectional views. Sectional views of simple machine elements

b) **Threaded fasteners** - Screw threads and their conventional representation. ISO metric thread and square thread forms. Hexagonal and square headed nuts and bolts. Types of screws and bolts used in machine assembly. Introduction to computer aided 2D drafting and 3D modelling. (Only practice, no university examination.)

Module - I (12 hours - 3 drawing exercises)

a) **Joints** - Bolted joints using hexagonal, square and stud bolts and nuts. Nut locking arrangements, foundation bolts-eye end, hook-end, split-end type, rag-end, square plate type and Lewis foundation bolts. Types of cotters and pins. Socket and spigot joint, sleeve and cotter joint, strap joint and knuckle joint.

b) **Couplings and pulleys** -Types of shaft keys and their proportions. Solid and split muff couplings. Flanged couplings- protected and flexible type. Claw coupling. Universal coupling. Flat pulleys. V-pulleys. Stepped cone pulley.

(Sketches are to be drawn for a given size of the machine part, adopting standard proportions)

Module - II (16 hours - 3 drawing exercises)

a) **Tolerances and Fits** - Limits and tolerances of machine parts - Hole system and shaft system of tolerances, designation of fundamental deviation. Types of fits and their selection. Indication of dimensional tolerances and fits on simple machine parts. Geometrical tolerances - recommended symbols - indication of geometrical tolerances on simple machine parts. Surface roughness - Indication of surface finish on drawings. Preparation of shop floor drawings of simple machine parts.

b) **Bearings** - Solid journal bearings, bushed bearings, plummer block and footstep bearings. Types of rolling contact bearings. Conventional representation of ball and roller bearings. Assembly of radial and thrust type rolling contact bearings in housing.

(Scaled drawings of machine parts or their assembly showing dimensional tolerance are to be prepared.)

Module - III (24 hours - 6 drawing exercises)

a) **Assembly of engine and machine tool parts** - Strap end of connecting rod. I.C. engine connecting rod. Piston of four stroke engine. Simple eccentric. Lathe tool post. Lathe tail stock. Four jaw chuck. Drill press vice. Drill jig - post type. Drill jig - indexing type.

b) Assembly of miscellaneous machine parts - Screw jack. Swivel bearing. Crane hook. Pipe vice. Stuffing box. Gate valve. Glob valve. Ball valve. Non return valve. Assembly of the bracket and gland of centrifugal pump. (Scaled drawings of assembled views are to be practiced)

NOTE: *All drawing exercises mentioned above are for class work. Additional exercises where ever necessary may be given as home assignments.*

Sectional work assessment:

Drawing exercises (Best 10)	10x3	= 30
2 Tests	2x 10	= 20

Total marks = 50

References:

1. K.C. John - "Machine Drawing" - Jet Publications
2. N.D. Bhutt and Panchal- "Machine Drawing" - Charator Publishing House.
3. P.S. Gill - "A text Book of Machine Drawing" - B.D Kataria & Sons.
4. Luzadder, W. J.- "Fundamentals of Engineering Drawing" Prentice Hall of India.

University examination Pattern:

No question from module 0

Q I - Two questions a and b of 20 marks each from module - I, with choice to answer any one.

Q II - Two questions a and b of 30 marks each from module - II, with choice to answer any one.

Q III- Two questions a and b of 50 marks each from module - III, with choice to answer any one.

ME04 306: ELECTRICAL ENGINEERING

3 hours lecture & 1 hour tutorial per week

Module-I

Three phase induction motors: Types and constructional details - Production of rotating magnetic field - Principle of operation - Slip of induction motor - Starting characteristics - Steady state characteristics - Equivalent circuit, Torque equations - Steady state torque-slip characteristics - Effect of harmonics in the stator voltage - Effect of rotor resistance on the torque-slip characteristics - No-load and blocked rotor tests - Predetermination of steady state characteristics using equivalent circuit - method of starting of induction motors - Comparison between squirrel cage and slip ring induction motors - Single phasing - Application of induction motors

Module-II

Electrical drives: Advantages of electrical drives - Parts of electrical drives - Choice of electric drives Status of DC and AC drives - Dynamics of Electric drives - Fundamental torque equations - Multi-quadrant operation - Equivalent values of drive parameters - Components of load torque - Nature and classification of load torque - Steady-state stability - Load equalization

Module-III

Electrical drives: Power semiconductor devices - Symbol and control characteristics - Input-output characteristic of AC to DC, AC to AC and DC to DC converters –(no derivation and waveforms) - Principle of square wave & PWM inverters - Three phase induction motor drives - Performance characteristics - Stator voltage control - Rotor voltage control - Frequency control - Voltage and frequency control

Module-IV

Synchronous machines: Alternators - Constructional details - Types - emf equation - Armature reaction - Phasor diagram - Regulation by emf method - Operation on infinite bus bar - Effect of change of excitation and fuel input - Synchronous motors - Principle of operation - Methods of starting load angle - Power curve - Damper bars - Hunting - Applications - Servo motors, Stepper Motors

Reference books

1. Hughes E., *Electrical Technology, ELBS*
2. Nazareth & Kothari, *Electrical Machines,* Tata McGraw Hill
3. Langdrorf A.S., *Theory of AC Machines*, McGraw Hill
4. Dubey G.K., *Fundamentals of Electrical Drives*, Narosa
5. Rashid M.H., *Power Electronics*, Prentice Hall of India

Sessional work assessment

Two Tests = 30

Two Assignments = 20

Total marks = 50

University examination pattern

Q I - 8 short type questions of 5 marks each, 2 from each module

Q II - 2 questions A and B of 15marks each from module I with choice to answer any one

Q III - 2 questions A and B of 15marks each from module II with choice to answer any one

Q IV - 2 questions A and B of 15marks each from module III with choice to answer any one

Q V - 2 questions A and B of 15marks each from module IV with choice to answer any one

ME04 307(P) ELECTRICAL ENGINEERING LAB

3 hours per week

1) a. Determination of voltage-current relation of a linear resistance and incandescent lamp
   b. Measurement of high and low resistance using voltmeter and ammeter

2) R, Land C series and parallel circuits: measurement of voltage-current relation and verification by calculation - plotting the instantaneous power against time

3) Calibration of the single phase energy meter by direct loading at various power factors

4) Measurement of power in the three phase circuit using single, two and three wattmetersfor balanced load and for three and four wire system

5) Determination of the efficiency and regulation of single phase transformer by direct loading

6) Determination of the equivalent circuit of transformer by open and short circuit test - calculation of efficiency and regulation at various loads and power factors

7) Determination of the regulation of alternator by emf and mmf methods

8) Synchronization of alternator to the AC mains and studying the effect of changes in excitation for alternator and power input to alternator by plotting the V -curve

9) Starting the cage induction motor using star-delta switch and plotting the performance characteristics

10) Conducting the no load and blocked rotor test on slip ring induction motor - determining equivalent circuit and calculating torque-slip characteristics

11) Plotting acc of DC shunt generator at rated speed - determining the critical resistance

12) Conducting load test on DC shunt generator and plotting external characteristics - deducing internal characteristics

Sessional work assessment

Lab practicals & record = 30
2 tests 2x10 = 20
Total marks = 50

ME04 308(P) ME04 304 MATERIAL TESTING LAB

1) Standard tension test on mild steel using Universal Testing Machine and suitable extensometers

2) Stress - strain characteristics of brittle materials - Cast iron

3) Spring test - open and closed coiled springs - determination of spring stiffness and modulus of rigidity

4)Determination of modulus of rigidity of wires

5)Hardness tests - Brinnell hardness, Rockwell hardness (B S C scales). Rockwell superficial hardness

(N & T scales) & Vickers hardness

6) Impact test - Izod and Charpy

7) Bending test on beams

8) Fatigue testing - study of testing machine

9) Photoelastic method of stress measurements (two dimensional problems)

Sessional work assessment

Lab practicals & record = 30
2 tests 2x10 = 20
Total marks = 50

FOURTH SEMESTER

Code	Subject	Hours/Week			Sessional Marks	University Examination	
		L	T	P/D		Hrs	Marks
ME04 401	Engineering Mathematics IV	3	1	-	50	3	100
ME04 402	Environmental Studies	3	1	-	50	3	100
ME04 403	Thermodynamics	3	1	-	50	3	100
ME04 404	Metallurgy and Material Science	3	1	-	50	3	100
ME04 405	Advanced Mechanics of Solids	3	1		50	3	100
ME04 406	Fluid Machinery	3	1	-	50	3	100
ME04 407(P)	Fluid Mechanics & Machinery Lab	-	-	3	50	3	100
ME04 408(P)	Production Engineering Lab I	-	-	3	50	3	100
TOTAL		18	6	6	400	-	800

ME04 Engineering Mathematics IV (to be Prepared)

ME04 402 ENVIRONMENTAL STUDIES (To be Prepared)

ME04 403 : THERMODYNAMICS

3 hours lecture and 1 hour tutorial per week

Module I (13 hours)

Basic concepts and definitions – system and control volume, state, properties. processes and cycles – work and heat – thermodynamic equilibrium – zeroth law law of thermodynamics – temperature scales.

First law of thermodynamics – joule's experiment – first law applied for a change of state – internal energy and enthalpy – first law applied for open system – steady flow energy equation – applications.

Module II (13 hours)

Second law of thermodynamics – Kelvin Planks and Clausius statements and their equivalence – heat engine – heat pump – thermal reservoir – Carnot cycle – Carnot theorems – thermodynamic temperature scale – Clausius inequality – reversible and irreversible process – entropy – principle of entropy increase application of second law for open system – availability and irreversibility - Gibb's , Helm holtz function- third law of thermodynamics.

Module III (13 hours)

Thermodynamic relations – maxwell's relation – Clausius clapeyron equation – Tds relations – equation for internal energy and enthalpy. Joule Thomson coefficient – mixture of gases – Dalton's law, Amagal's law-entropy change of mixture- properties of atmospheric air-Use of psychrometric chart.

Properties of pure substance – P-T, T-S and T-V diagrams – use of steam tables and mollier diagram – properties of real gases – compressibility chart – law of corresponding states.

Module IV (13 hours)

Thermodynamics of combustion – combustion reaction of common fuels – air fuel ratio – exhaust gas composition – flue gas analysis – air fuel ratio from exhaust gas composition – enthalpy of formation – application of first law of thermodynamics to chemically reacting systems-enthalpy and internal energy of combustion- adiabatic flame temperature.

Text book

1. . P. K. Nag, Thermodynamics, Tata Mc Graw Hill

Reference books

1. Yunus Cengel, Thermodynamics an Engineering Approach, Fourth Edition, Mc Graw Hill
2. C. P. Arora, Thermodynamics, Tata Mc Graw Hill
3 . Y V C Rao ,An Introduction To Thermodynamics Unversities Press .
4. R. Yadav, A Text book on Thermodynamics, Central Publishing House
5. Sonntag and Van Wylen, Fundamentals of Thermodynamics, Sixth edn John Wiley & Sons.

Sessional work assessment

Two Tests = 30

Two Assignments = 20

Total marks = 50

University examination pattern

Q I - 8 short type questions of 5 marks each, 2 from each module

Q II - 2 questions A and B of 15marks each from module I with choice to answer any one

Q III - 2 questions A and B of 15marks each from module II with choice to answer any one

Q IV - 2 questions A and B of 15marks each from module III with choice to answer any one

Q V - 2 questions A and B of 15marks each from module IV with choice to answer any one

ME 04 404 METALLURGY AND MATERIAL SCIENCE

(3 hours lecture and 1 hour tutorial per week)

Module I (12 hours)

Classification of Engineering materials – properties of engineering materials – levels of structure – macro structure – micro structure – crystal structure – electronic and nuclear structures – crystallography of metals – crystal systems – miller indices – crystal directions and planes – BCC , FCC and CPH structures – automatic packing factor – structure determination – study of micro structure – surface preparation for metallographic examination – etching and common etchants – metallurgical microscope – electron microscope – X ray diffraction techniques -Metallic bonds – polymorphism and allotropy .

Module II (15 hours)

Deformation of crystals – slip and twinning– Von mises and Hencky theory – slip lines - slip bands – critical resolved shear stress imperfections in solids – point defect – line defect – surface defects – volume defects – electronic defects – Edge dislocation and screw dislocation – Sources of dislocation – Frank Reid source – Crystallization of metals – Cast metal structures – Recovery and recrystallysation - grain growth – strain hardening-hot working and cold working - failure of materials– mechanism of creep - creep resistant materials – fracture – brittle and ductile fracture – protection against fracture – Fatigue mechanism – S-N curve.

Module III (15 hours)

Diffusion – patterns of diffusion – equilibrium diagrams – phases – structural constituents – solid solutions – types of solid solutions – HumeRothery rules – thermal equilibrium diagrams – Glibbs phase rule- Cooling curves – lever rule – isomorphous system - Cu-Ni, Bi-Cd; Pb-Sn and Iron-Carbide equilibrium diagram – heat treatment of steels – annealing – normalizing- spheroidising – time temperature – transformation diagram – hardening – hardenability –factor affecting hardenability - austempering and martempering - tempering of steel – precipitation hardening – case hardening – nitriding – surface treatment methods – induction hardening – flame hardening .

Module IV (12 hours)

Steels – Functions of alloying elements in steel – tool steels – stainless steels – cast iron – grey , white and S.G. Castirons - structure of cast iron – copper alloys and their uses – aluminium alloys and their uses – glasses – types of glass- forming agents- Composites – types – application – recent dvelopments in materials – smart materials –Nanomaterials - shape memory alloys.

Textbooks

1.Raghavan " Material science and Engineering" – Printice Hall of India

2.Higgins R A " Engineering Metallurgy "– Part I applied physical metallurgy;ELBS

Reference:

1. A G Guy
2. Allen Cottell

Sessional work assessment

Two Tests = 30

Two Assignments = 20

Total marks = 50

University examination pattern

Q I - 8 short type questions of 5 marks each, 2 from each module

Q II - 2 questions A and B of 15marks each from module I with choice to answer any one

Q III - 2 questions A and B of 15marks each from module II with choice to answer any one

Q IV - 2 questions A and B of 15marks each from module III with choice to answer any one

Q V - 2 questions A and B of 15marks each from module IV with choice to answer any one

ME04 405 : ADVANCED MECHANICS OF SOLIDS
3 hours lecture & 1 hour tutorial per week

Module I (13 hours)
Basic equations of elasticity - Stress at a point - Nature of stress at a point - Stress tensor - Stress transformation - Principal stresses and planes - Strain at a point - Strain tensor analogy between stress and strain tensors - Constitutive equations - Generalized Hook's law - Equations of equilibrium - Strain displacement relations - Compatibility conditions - Boundary conditions

Module II (13 hours)
Two dimensional problems in elasticity - Plain stress and plain strain - Airy's stress function - Solution by polynomial - Equations in polar co-ordinates - Stress concentration - Axisymmetric problems - Thick cylinders Inference fit - Rotating disks- equilibrium equations.

Module III (13 hours)
Special problems in bending - Unsymmetrical bending - Shear centre - Energy methods in elasticity - Strain energy - Principle of virtual work - Reciprocal theorem - Castigliano's first and second theorems - Complementary energy

Module IV (13 hours)
Torsion of non-circular prismatic bars - Saint Venant's theory - Solution for simple cases - Prandtl membrane analogy - Open and closed sections - Shear flow

Text book

1. Srinath L S, Advanced strength of Materials, McGraw Hill

Reference books
1. Den Hartog J P, Advanced Strength of Materials, McGraw Hill
2. Timoshenko S P & Goodier J N, Theory of Elasticity, McGraw Hill
3. Filonenoko M & Borodich, Theory of Elasticity , Mir Publishers
4. Wang C K, Applied Elasticity, McGraw Hill

University examination pattern
Q I - 8 short type questions of 5 marks each, 2 from each module
Q II - 2 questions A and B of 15marks each from module I with choice to answer any one
Q III - 2 questions A and B of 15marks each from module II with choice to answer any one
Q IV - 2 questions A and B of 15marks each from module III with choice to answer any one
Q V - 2 questions A and B of 15marks each from module IV with choice to answer any one

ME04 406: FLUID MACHINERY

3 hours & 1 hour tutorial per week

Module I (13 hours)

Integral form of continuity, momentum and energy equations- Flow of fluids over flat plates and curved surfaces- Force, work done and efficiency- Reaction principles- Propulsion of ships-Dimensional analysis- Rayleigh's method and Buckingham’Pi’ theorem- Principles of modeling and similitude as applied to fluid mechanics problems- Non-dimensional parameters in fluid mechanics and fluid machinery.

Module II (13 hours)

Euler's turbine equation- Analysis of turbines- classifications of turbines - Constructional features of Pelton, Francis and Kaplan turbines- Speed regulation of turbines- Study of performance - Model studies- Theory of draft tubes- Cavitation in turbines.

Module III (11hours)

Rotodynamic pumps - Whirling of fluid - Vortex motion - Free and forced vortex - Spiral flow - Features of rotodynamic and positive displacement pumps - Constructional features of centrifugal pumps - Principle of working - Analysis - Euler's equation - Efficiencies - Types of centrifugal pumps - Pump characteristics - Pump selection - Model studies - Cavitation in pumps – design of pumps – design criteria – selection of pumps – criteria for selection – determination of power of pumps.

Module IV (15 hours)

Reciprocating pumps - Principle of working - Effect of accelaration and friction - Use of air vessels - Cavitation - Pump characteristics - Working principle of axial and radial piston pumps, vane pump and gear pump - Miscellaneous fluid devices - Fluid transients - Analysis of transients in fluid flow - Operation of hydraulic ram and surge tank . Deep well, submersible pumps, screw pump, jet pump – hydraulic break – fluid coupling - Intensifier and accumulator - Application to hydraulic devices (descriptive study only)

Text book

Jagdish Lal, Hydraulic Machines, Metropolitan

Reference books

Govinda Rao, Fluid Flow Machines, Tata McGraw Hill

Shepherd D G, Principles of Turbo Machinery, McMillan

Stepanof A J, Centrifugal and Axial Flow Pumps, John Wiley

Binder R C, Advanced Fluid Mechanics- Vol.1, Prentice Hall

Sessional work assessment

Two Tests = 30

Two Assignments = 20

Total marks = 50

University examination pattern

Q I - 8 short type questions of 5 marks each, 2 from each module

Q II - 2 questions A and B of 15marks each from module I with choice to answer any one

Q III - 2 questions A and B of 15marks each from module II with choice to answer any one

Q IV - 2 questions A and B of 15marks each from module III with choice to answer any one

Q V - 2 questions A and B of 15marks each from module IV with choice to answer any one

ME04 407(P):FLUID MECHANICS & MACHINERY LAB

1) Study of plumbing tools and pipe fittings

2) Measurement of Metacentric height and radius of gyration of floating bodies

3) Measurement of Viscosity of fluids

4) Study of discharge measuring instruments

5) Measurement of pressure and velocity

6) Calibration of ventprimeter

Orifice meter

Notches and weirs

Nozzle meters

Rotameters

7) Pipe friction - Minor losses in pipes - Verification of BemoulJis theorem

8) Demonstration of laminar and turbulent flow in pipes - Critical velocity

9) Demonstration of Forces on curved and plane surfaces

10) Evaluation of torque & performance of turbines - operating characteristics - Muschel's curves

11) Performance of pumps

Centrifugal pumps

Reciprocating pumps

Gear pumps

Hydraulic ram

Torque Coverter

ME04 408(P):MACHINE SHOP PRACTICE I

1) Study of Machine tools and machining processes - Specification of machine tools; power sources.

a) Lathes

b)Shaper

c)Planer

d)Slotting Machine

e) Drilling Machine

f) Milling Machine

g) Grinding Machine

h) Power saws

2) Study of Centre lathe - General features, parts and functions –Different machining operations on centre lathe - turning, taper turning , thread cutting ,. drilling, boring, reaming , tapping , profile turning , knurling .

3) Study of Lathe cutting tools – Tool materials – HSS – HCS - Carbide ..

4) Study of Tolerances and surface finish – Measuring Tools and Gauges .

7) Exercises: on centre lathe requiring simple turning , taper turning , knurling , boring and thread cutting

FIFTH SEMESTER

Code	Subject	Hours/Week			Sessional Marks	University Examination	
		L	T	P/D		Hrs	Marks
ME04 501	Numerical Analysis	3	1	-	50	3	100

ME04 502	Heat & Mass Transfer	3	1	-	50	3	100
ME04 503	Economics & Industrial Management	3	1	-	50	3	100
ME04 504	Mechanics of Machinery	3	1	-	50	3	100
ME04 505	Metal Cutting and Forming	3	1	-	50	3	100
ME04 506	Instrumentation & Metrology	3	1	-	50	3	100
ME04507(P)	Measurements Lab	-	-	3	50	3	100
ME2K 508(P)	Production Engineering Lab II	-	-	3	50	3	100
TOTAL		18	6	6	400	-	800

ME04 501 : NUMERICAL ANALYSIS

3 hours lecture and 1 hour tutorial per week

Module I: Errors in numerical calculations (13 hours)

Sources of errors, significant digits and numerical instability - numerical solution of polynomial and transcendental equations - bisection method - method of false position - Newton-Raphson method - fixed-point iteration - rate of convergence of these methods - iteration based on second degree equation - the Muller's method - Chebyshev method - Graeffe's root squaring method for polynomial equations - Bairstow's method for quadratic factors in the case of polynomial equations

Module II: Solutions of system of linear algebraic equations (13 hours)

Direct methods - Gauss and Gauss-Jordan methods - Crout's reduction method - error analysis - iterative methods - Jacobi's iteration - Gauss-Seidel iteration - relaxation method - convergence analysis - solution of system of nonlinear equations by Newton-Raphson method - power method for the determination of Eigenvalues - convergence of power method

Module III: Polynomial interpolation (13 hours)

Lagrange's interpolation polynomial - divided differences - Newton's divided difference interpolation polynomial - error of interpolation - finite difference operators - Gregory-Newton forward and backward interpolations - Stirling's interpolation formula - interpolation with a cubic spline - numerical differentiation - differential formulae in the case of equally spaced points - numerical integration - trapezoidal and Simpson's rules - Gaussian integration - errors of integration formulae

Module IV: Numerical solution of ordinary differential equations (13 hours)

Taylor series method - Euler and modified Euler methods - Runge-Kutta methods (2nd order and 4th order only) - multistep methods - Milne's predictor-corrector formulae - Adam-Bashforth and Adam-Moulton formulae - solution of boundary value problems in ordinary differential equations - finite difference methods for solving two dimensional Laplace's equation for a rectangular region - finite difference method of solving heat equation and wave equation with given initial and boundary conditions

Reference books

1.Froberg C.E., Introduction to Numerical Analysis, Addison Wesley

2.Gerald C.F., Applied Numerical Analysis, Addison Wesley

3.Hildebrand F.B., Introduction to Numerical Analysis, T.M.H.

4.James M.L., Smith C.M. & Wolford J.C., Applied Numerical Methods for Digital Computation, Harper & Row

4.Mathew J.H., Numerical Methods for Mathematics, Science and Engineering, P.H.I

Sessional work assessment

Assignments	2x10=20
2 tests	2x15=30
Total marks	=50

University examination pattern

Q I - 8 short type questions of 5 marks each, 2 from each module

Q II - 2 questions A and B of 15marks each from module I with choice to answer any one

Q III - 2 questions A and B of 15marks each from module II with choice to answer any one

Q IV - 2 questions A and B of 15marks each from module III with choice to answer any one

Q V - 2 questions A and B of 15marks each from module IV with choice to answer any one

ME04 502 : HEAT & MASS TRANSFER

3 hours lecture & 1 hour tutorial per week

Module I (13 hours)

Introduction : Basic modes of heat transfer.

Conduction – General heat conduction equation in Cartesian , cylindrical , spherical coordinates-one dimensional steady state conduction with and with out heat generation –critical insulation thickness-extended surface heat transfer. Heat transfer from buried cables-variable thermal conductivity.

Two dimensional steady state conduction through plane wall- conduction shape factor.

Unsteady state conduction in one dimension – lumped heat capacity system- semi infinite solid with sudden and periodic change in surface temperature.

Module II (13 hours)

Convection- Newton's law – concept of boundary layer – significance of Prandtl number – boundary layer equations – flat plate heat transfer solutions by integral method – laminar and turbulent flow – Reynolds analogy – empirical relations in forced convection.

Natural convection - heat transfer from vertical plate by integral method – empirical relation in free convection.

Condensation and boiling – film and drop wise condensation – film boiling and pool boiling - boiling curve-empirical relations for heat transfer with change of face.

Module III (13 hours)

Radiation – Fundamental of radiation – Radiation spectrum – thermal radiation – concept of black body – monochromatic and emissive power- absorptivity ,reflectivity- transmissivity-emissivity- Planks law-Lambert's law – Kirchoff's law-radiation between two surfaces – geometrical factors for simple configuration – radiation shields- electrical net work method of solving problems.

Module IV (13 hours)

Heat exchangers – type of heat exchangers – log mean temperature difference- over all heat transfer coefficient- fouling and scaling of heat exchangers – NTU method of evaluation of heat exchangers – heat exchanger effectiveness.

Introduction to mass transfer – Ficks law of diffusion – thermal evaporation into air – mass transfer coefficients.

Text book

Holman J.P., "Heat Transfer," McGraw Hill International Students Edition

Reference books

1.Heat and Mass Transfer : Dr.D.S.Kumar

2.Heat Transfer : Binay K Dutta

3.Essential Heat Transfer : Christopher A Long

4.Heat and Mass Transfer : Raj put

5.Heat and Mass Transfer : Sarit K Das

6.Y V C Rao Heat Transfer , Universities Press

Sessional work assessment

Two Tests = 30

Two Assignments = 20 (Some of the probelsm of assignment should be computer based)

Total marks = 50

University examination pattern

Q I - 8 short type questions of 5 marks each, 2 from each module

Q II - 2 questions A and B of 15marks each from module I with choice to answer any one

Q III - 2 questions A and B of 15marks each from module II with choice to answer any one

Q IV - 2 questions A and B of 15marks each from module III with choice to answer any one

Q V - 2 questions A and B of 15marks each from module IV with choice to answer any one

ME04 503 : ECONOMICS & INDUSTRIAL MANAGEMENT

3 hours lecture & 1 hour tutorial per week

Module I (13 hours)

Nature and scope of economics –definitions of macro and micro economics - basic terminologies - goods - utility - value - wealth - factors of production - land - labour - division of labour - capital and capital formation - consumption - wants - characteristics and classification - law of diminishing marginal utility - demand - law of demand - elasticity of demand - types of elasticity - factors determining elasticity - measurement - its significance - supply - law of supply - elasticity of supply - market price - perfect competition - monopoly - monopolistic competition

Module II (13 hours)

Forms of business - proprietorship - partnership - joint stock company - cooperative sector - state enterprises

National income – concepts – GNP - theory of money - nature and functions of money- inflation and deflation - taxation - direct and indirect tax

International trade - distinction between national and international trade - theory of international trade - free trade v/s protection - balance of trade and balance of payments - trade policy of the Government of India

Module III (13 hours)

Management - systems concepts of management - principles of planning – organizing and directing -management by objectives – types of organizations and structures - span of control - delegation - leadership - directing – controlling .

Human resources management - job design - job evaluation - merit rating - wages and incentives - work study - method study - time study –memo motion and micromotion study - work sampling - human behaviour and work environment interface – work place design –econometrics –ergonomics

Module IV (14 hours)

Costing and accounting - concepts - elements of cost - overhead costs - methods of allocation of overhead costs - depreciation - methods of depreciation - financial management - time value of money - comparison of alternatives -payback period method - net present value - internal rate of return - basics of financial accounting - profit and loss accounts - balance sheets.

Marketing – concepts - marketing environment - marketing mix – market research - advertising and sales promotion - product life cycle

Text books

Text books

1. Dewett K.K. & Varma J.D., Elementary Economic Theory, S Chand
2. Barthwal R.R., Industrial Economics- An Introductory Text Book, New Age
3 .Pandey I.M., Financial Management, Eighth Edition, Vikas Publishing House Private Limited
4. Bhattacharya A.K., Principles and Practice of Cost Accounting, Wheeler Publishing

Reference books

1. Koontz H., O'Donnel & Weihrich H., Essentials of Management, McGraw Hill Book Company
Mazda F., Engineering Management, Low Price Edition, Addison Wesley
2.Venkata Ratnam C.S. & Srivastava B.K., Personnel Management and Human Resources, Tata McGraw Hill Publishing Company Limited
3. Kotler P., Marketing Management: Analysis, Planning, Implementation and Control, Prentice Hall of India Private Limited
4. Jhingan M.L., Micro Economic Theory, Konark
6. Ramaswamy V.S. & Namkumari S., Marketing Management: Planning, Implementation and Control, Macmillan India Limited
8. Prasanna Chandra, Financial Management: Theory and Practice, Fourth Edition, Tata McGraw Hill Publishing Company Limited

Sessional work assessment

Two Tests = 30

Two Assignments = 20

Total marks = 50

University examination pattern

Q I - 8 short type questions of 5 marks each, 2 from each module

Q II - 2 questions A and B of 15marks each from module I with choice to answer any one

Q III - 2 questions A and B of 15marks each from module II with choice to answer any one

Q IV - 2 questions A and B of 15marks each from module III with choice to answer any one

Q V - 2 questions A and B of 15marks each from module IV with choice to answer any one

ME04 504 : MECHANICS OF MACHINERY
3 hours lecture & hour tutorial per week

Module I (13 hours)

Introduction to kinematics and mechanisms - Various mechanisms, kinematic diagrams, degree of freedom- inversions Coupler curves - straight line mechanisms- exact, approximate – Hooke's joint - Geneva Mechanism - Displacement and velocity analysis - Position and displacement analysis - Relative motion - Velocity analysis - Instant centre - Complex number method - Mechanical advantage - Acceleration analysis - Relative accelaration - Coriolis acceleration - Graphical and analytical methods - Computer oriented methods

Module II (13 hours)

Cam design - Cam and follower types - Displacement diagrams, Velocity and acceleration analysis of SHM, Uniform Velocity, Uniform acceleration, Cycloidal – Graphical Cam profile synthesis –Pressure angle-Analysis of Tangent cam with roller follower and Circular cam with flat follower.

Module III (13 hours)
Gears - Involute spur gears - Involutometry - Spur gear details – Contact ratio - Interference - Gear standardization - Backlash - Internal gear - Non-standard gears Centre distance modification, Long and Short Addendum system. - Theory and details of bevel, helical and worm gearing - Gear trains - Simple and compound gear trains - Planetary gear trains – Differential -Solution of planetary gear train problems - Applications

Module I (13 hours)
Kinematic synthesis - Tasks of kinematic synthesis - Type and dimensional synthesis - Graphical synthesis for motion - Path and prescribed timing - Function generator – 2 position and 3 position synthesis – Overlay Method - Analytical synthesis techniques - Complex number modelling - Freudenstein's equation – Bloch's synthesis - technique - One case study in synthesis of mechanism.
Note: Computer oriented assignments are to be included.

Text books

1. Shigley J E & Uicker J J, Theory of Machines and Mechanisms, McGraw Hill
2. Mabie H H & Reinholtz C F, Mechanisms and Dynamics of Machinery, John Wiley

Reference books

1. Ghosh A & Malik A K, Theory of Mechanisms and Machines, Affiliated East West Press
2. Erdman A G & Sandor G N, Mechanism Design: Analysis and synthesis Vol I & II, Prentice Hall of India
3. Myskza published by Pearson Education

Sessional work assessment

Two Tests	= 30
Two Assignments	= 20 (Some problems of the Assignments should be computer based)
Total marks	= 50

University examination pattern

Q I - 8 short type questions of 5 marks each, 2 from each module

Q II - 2 questions A and B of 15marks each from module I with choice to answer any one

Q III - 2 questions A and B of 15marks each from module II with choice to answer any one

Q IV - 2 questions A and B of 15marks each from module III with choice to answer any one

Q V - 2 questions A and B of 15marks each from module IV with choice to answer any one

ME04 505 :METAL CUTTING AND FORMING

3 hours lecture and 1 hour tutorial per week

Module I (13 hours)

Machine tools: basic concepts - tool - work motion - cutting variables - machining time - drive mechanisms - layout of speeds - ray diagram for machine tool gear boxes - stepped and stepless speed drives - turret lathe - tool layout -automats - interchangeable system of manufacture - limits, fits and tolerances - gauging of components - gauging of threads and gears - optical measurements

Module II (13 hours)

Tool materials - tool geometry - mechanics of chip formation - orthogonal and oblique cutting - cutting forces - merchant's analysis of cutting force - shear angle - velocity relationships - cutting power - tool in hand nomenclature of drills, milling cutters & broaches - grinding wheel designation - tool wear and tool life - tool life equation - machinability - economics of machining - cutting fluids and their selection

Module III (13 hours)

Press working operations - presses for sheet metal working - constructional features - die cutting operations - die/punch size estimation - scrap - strip layout - centre of pressure and press tonnage - compound & progressive dies - jigs and fixtures: basic principles - locating and clamping elements - fixture/jig for simple components.

Module IV (13 hours)

Basic concepts of NC systems - classification of NC systems - NC & CNC - incremental and absolute system - features of NC machine tools - NC part programming - tape format - point to point and contour programming - APT language - industrial robots - basic principles and application - computer integrated manufacturing systems

Reference books

HMT, Production Technology, Tata McGraw Hill

Ghosh & Mallik, Manufacturing Science, Affiliated East West Press

Bhattacharyya A., Metal Cutting: Theory & Practice, Central Book Publishers

Juneja & Skekhon, Fundamentals of Metal Cutting and Machine Tools, Wiley Eastern

Sharms P.C., A Text book of Production Engineering, S. Chand & Company

Groover & Zimmer, CAD/CAM, Prentice Hall of India

Yoram Koren, Computer Control of Manufacturing Systems, McGraw Hill Book Company

Jain R.K., Engineering Metrology, Khanna Publishers

Mullick & Bhattacharyya, Technology of Machining Systems, New Central Book Agency

Mehta, Machine Tool Design and Numerical Control, Tata McGraw Hill Publishing Company

ASTME, Fundamentals of Tool Design, Prentice Hall of India

Sessional work assessment

Two tests	= 30
Two assignments	= 20
Total marks	= 50

University examination pattern

Q I - 8 short type questions of 5 marks each, 2 from each module

Q II - 2 questions A and B of 15marks each from module I with choice to answer any one

Q III - 2 questions A and B of 15marks each from module II with choice to answer any one

Q IV - 2 questions A and B of 15marks each from module III with choice to answer any one

Q V - 2 questions A and B of 15marks each from module IV with choice to answer any one

ME 04 506 INSTRUMENTATION AND METROLOGY

(3 hours lecture and 1 hour tutorial per week)

Module I (12hours)

Mechanical measurement – direct comparison and indirect comparison – the generalized measurement system – types of input quantities – measurement standards – calibration – uncertainty – systematic and random errors – common types of errors – classifications of errors – terms used in rating instrument performance – introduction to uncertainty – propagating uncertainity Kline and Mc lintock approach – zero first and second order instruments – methods of correcting for spurious inputs – inherent insensitivity – high gain feed back – signal filtering and opposing inputs.

Module II (15 hours)

Sensors – loading error – primary and secondary transducers – compatibility of mechano electric transducer combination – variable resistance transducers - sliding contact devices – variable inductance elements – self inductance and mutual inductance elements – differential transformer – construction and characteristics – rotary differential transformer –variable reluctance transducer – capacitance transducers – active and passive transducers – piezo electric transducers – photoelectric sensors – Hall effect transducers – resistance wire strain gages – types – theory of metallic strain gauges – selection and installation – strain gauge circuits – ballast circuit – bridge circuit – bridge with two and four arm sensitivity – calibration of strain gauges – measurement of strain in rotating shafts – measurement of pressure – standards of pressure – measurement of high pressure – bulk modules gauge – measurement of low pressure – the Mc Leod Gauge – thermal conductivity gauges – ionizing gauges.

Module III (12 hours)

Measurement of temperature – liquid in glass thermometer – complete partial and total immersion thermometers – resistance thermometers – constructional details – resistance thermometer circuits – lead wire compensation for resistance thermometers – thermistors – constructional details – measuring circuits for thermistors – thermo electric thermo meters – laws of thermocouples – industrial thermocouples and their ranges – making of thermocouple junctions – ambient temperature compensation- use of extension heads – pyromeres – optical total radiation and photo electric pyrometers-linear Quartz thermometer - measurement of flow – need for flow metering – rotameter – theory and constructional details – magnetic flow meters – hotwire anemometers – drag force flow meter

Module IV (15 hours)

Linear and angular measurement – slip gauges stack of slip gauge – method of selecting slip gauges – adjustable slip gauge – measurement of angles – sine bar checking unknown angles- sine center – sources of error – angle gauges – optical instruments for angular measurement- auto collimator – applications – straightness and square ness – angledekkor – precision spirit levels – Clinometers – measurement of surface roughness – surface texture – primary texture – secondary texture and the lay specification for surface textures – methods of measuring surface finish . The Talysurf instrument – the profilograph – Tomlinson surface meter – Tracer type profilograph – measurement of screw thread profiles – errors in pitch – microscopic method -measurement of internal thread – measurement of effective diameter – two wire and three wire method – measurement of root diameter – gear tooth measurement – measurement of gear profile –

tooth thickness – tooth spacing – pitch circle diameter – Parkinson's gear tester- the coordinate measuring machine construction – operation and programming – machine vision – image acquisition and digitization - image processing and analysis.

Textbooks

1. Ernest O Doebelin "Measurement systems" McGraw Hill Publishers
2. Beckwith, Marangoni ; Lien hard "mechanical measurements" ; Pearson Education
3..R K Jain "Engineering metrology"; Khanna Publishers, New.Delhi
4. R.K.Jain, Mechanical and Industrial measurements

Reference

1.I C Guptha; "Engineering Metrology"; Danpat Rai Publications.

2.Mickell. P.Grooer "Automation, Production Systems and Computer Integrated Manufacturing"; Pearson Education.

3.J.P.Holman, "Experimental Methods for Engineers"

4.Dr.D.S.Kumar, Mechanical Measurements

Sessional work assessment

2 tests	2x15 = 30
2 assignments	2x10 = 20
Total marks	= 50

University examination pattern

Q I - 8 short type questions of 5 marks each, 2 from each module

Q II - 2 questions A and B of 15marks each from module I with choice to answer any one

Q III - 2 questions A and B of 15marks each from module II with choice to answer any one

Q IV - 2 questions A and B of 15marks each from module III with choice to answer any one

Q V - 2 questions A and B of 15marks each from module IV with choice to answer any one

ME04 507(P) MEASUREMENTS LAB

3 hours practicals per week

I. (a) Determination of uncertainties in computed quantities such as the following

Volume of a rectangular block or cylinder computed from measurements of length, width, height and diameter

Water power computed from measurements of density, local acceleration due to gravity, volumetric flow rate and head

Shaft power computed from measurements of speed and torque

Electrical power computed from measurements of "number of rotations of energymeter disk", time taken and "energymeter constant"

Selection of instruments for computing quantities with desired uncertainties

Determination of bias and random error of the following instruments by calibrating them using proper standards

Load cells such as strain-gauge-load cells, strain-gauge-beam transducer etc.

Rotameter

Bourdon-tube pressure gauge

LVDT

Thermocouples

Tachometers

Constant area flow meters

III. (a) Preparation of a psychrometric chart for the laboratory and determination of psychrometric properties of atmospheric air- use of Sling psychrometer

Analysis of exhaust gases and flue gases with the help of orsats apparatus, gas chromatograph, paramagnetic oxygen analyser, smokemeter etc.

Acoustic measurements: sound level meter-octave band filter- preparation of noise contours

Plotting of velocity profiles using pitot tubes and hot wire anemometers

IV. Study of, and making measurements with: Water meter, velometers, pH meter, slip gauges, comparators, planimeter, pyrometers, RTDs, thermistors, CRO, multimeters, linear capacitance meters & LDR (light depended resistance)

V. Determination of static and dynamic characteristics of zero, first and second order instruments

Sessional work assessment

Laboratory practicals and record	= 30
Test/s	= 20
Total marks	= 50

ME04 508(P): MACHIME SHOP PRACTICE II

3 hours practicals per week

Introduction:

a) Limits , fits and tolerances .

b) Shaping machine - slotting machine - horizontal milling machine - vertical milling machine - surface, centreless and cylindrical grinders .

c) Spindle drives - milling cutters - indexing head .

d) Simple, Compound, Differential and Angular indexing .

Exercises

1) Excercices on Centre Lathe Including Multi-start thread ,Square thread,Eccentric turning ,

Internal thread

2) Exercises on Shaper Slotting Machine - cube with V – groove , slot and guide ways

3) Exercises on Milling Machine - Spur gear and Helical gear Milling by simple and differential indexing , Surface milling , slot and keyway milling

4) Exercises on Grinding and tool grinding

Reference books

HMT, Production Technology, Tata McGraw Hill

ASTME, Tool Engineer’s Handbook

Burghardt, Asilered & Anderson, Machine Tool Operations I & II, McGraw Hill

Chapman W.A.J., Workshop Technology: Part 2., Viva Low Priced Student Edition

Rao R.V., Metal Cutting and Machine Tools, S K Kataria & Sons

Sessional work assessment

Laboratory practicals and record = 30

Test/s = 20

Total marks = 50

SIXTH SEMESTER

Code	Subject	Hours/Week			Sessional Marks	University Examination	
		L	T	P/D		Hrs	Marks
ME04 601	I.C.Engines and Gas Turbines	3	1	-	50	3	100
ME04 602	Machine Design	3	1	-	50	3	100
ME04 603	Metal Casting & Joining	3	1	-	50	3	100
ME04 604	Mechatronics & Machine Controls	3	1	-	50	3	100
ME04 605	Operations Research	3	1		50	3	100
ME04 606	Dynamics of Machinery	3	1	-	50	3	100
ME04 607(P)	Thermal Engineering Lab I	-	-	3	50	3	100
ME04 608(P)	Mini Project	-	-	3	50	3	100
TOTAL		18	6	6	400	-	800

ME04 601 : I C ENGINES AND GAS TURBINES

3 hours lecture and 1 hour tutorial per week

Module I (14 hours)

Internal combustion engines –Engine components- Engine classification - four stroke and two stroke - spark ignition and compression ignition - valve timing diagram - air standard cycles - Otto, diesel and duel combustion cycles - actual engine cycles - effect of dissociation - variable specific heats and heat losses - scavenging - objectives - effects and methods

Module II (13 hours)

Systems and components of IC engines - fuel systems - ignition systems - cooling - starting - lubrication - governing of IC engines - supercharging of SI and CI engines - turbocharging - exhaust emissions of IC engines - alternate potential engines - free piston engine - Wankel engine and stratified charged engine - automotive transmission systems and its components - engine testing - performance and characteristics of constant speed and variable speed engines - heat balance test - Morse test - retardation test

Module III (12 hours)

Combustion in IC engines - flame propagation - normal and abnormal combustion - detonation - pre ignition - after burning - fuel rating - additives in petrol - combustion chambers of SI engines - Combustion in CI engines - phase of normal combustion - diesel knock - effect of engine variables on diesel knock - cetane number - additives in diesel - combustion chambers of CI engines

Module IV (13 hours)

Gas turbine plants - open and closed cycles - thermodynamic cycles - regeneration - reheating - intercooling - efficiency and performance of gas turbines - rotary compressors - analysis - centrifugal and axial flow compressors - combustion chambers of gas turbines - cylindrical - annular and industrial type combustion

chamber - combustion efficiency - axial flow turbines - elementary and vortex theories - design of nozzles and blades for turbines - limiting factors in turbine design

Text Books

Ganesan V "Internal Combustion Engines", Tata McGraw Hill

Ganesan V "Gas Turbines ", Tata McGraw Hill

Reference books

Rogowsky, "Elements of Internal Combustion Engines", Tata McGraw Hill

Gill, Smith & Ziurys, "Fundamentals of Internal Combustion Engines", Oxford and IBH

Maleev, "Internal Combustion Engine Theory and Design" McGraw Hill

Judge, "Modern Petrol Engines," Chapman & Hall

Benson & Whitehouse, "Internal Combustion Engines" Vol. I & II, Pergamon press

Mathur & Mehta, "Thermodynamics and Heat Power Engineering", Vol. I & II

Cohen & Rogers, "Gas Turbine Theory," Longmans

Sessional work assessment

2 tests	2x15 = 30
2 assignments	2x10 = 20
Total marks	= 50

University examination pattern

Q I - 8 short type questions of 5 marks each, 2 from each module

Q II - 2 questions A and B of 15marks each from module I with choice to answer any one

Q III - 2 questions A and B of 15marks each from module II with choice to answer any one

Q IV - 2 questions A and B of 15marks each from module III with choice to answer any one

Q V - 2 questions A and B of 15marks each from module IV with choice to answer any one

ME04 602 : MACHINE DESIGN

3 hours lecture and 1 hour tutorial per week

Module I (13 hours)

Introduction to design - steps in design process - design factors - tolerances and fits - principles of standardisation - selection of materials - strength of mechanical elements - stress concentration - theories of failure - impact load - fatigue loading - consideration of creep and thermal stresses in design

Module II (13 hours)

Threaded fasteners - thread standards - stresses in screw threads - preloading of bolts - bolted joints - eccentric loading - gasketed joints - analysis of power screws - keys: types of keys and pins - stresses in keys and pins - design of keys - design of cotter and pin joints - riveted joints - stresses in riveted joints - strength analysis - boiler and tank joints - structural joints

Module III (13 hours)

Welded joints - types of welded joints - stresses in butt and fillet welds - torsion and bending in welded joints - welds subjected to fluctuating loads - design of welded machine parts and structural joints - springs: stresses in helical springs - deflection of helical springs - extension, compression and torsion springs - design of

helical springs for static and fatigue loading - critical frequency of helical springs - stress analysis and design of leaf springs

Module IV (13 hours)

Power shafting - stresses in shafts - design for static loads - reversed bending and steady torsion - design for strength and deflection - design for fatigue loading - critical speed of shafts - stresses in couplings - design of couplings

Text book

Shigley J.E., Mechanical Engineering Design, McGraw Hill Book Company

Reference books

Siegel, Maleev & Hartman, Mechanical Design of Machines, International Book Company

Phelan R.M., Fundamentals of Mechanical Design, Tata McGraw Hill Publishing Co. Ltd.

Doughtie V.L., & Vallance A.V., Design of Machine Elements, McGraw Hill Book Company

Juvinall R.C. & Marshek K.M., Fundamentals of Machine Component Design, John Wiley

Data hand books (allowed for reference during examinations)

Prof. Narayana Iyengar B. R. & Dr Lingaiah K., Machine Design Data Handbook, Vol. I &II

P.S.G., Tech., Machine Design Data Handbook

Sessional work assessment

2 tests (best 2 out of 3 tests conducted)	2x15 = 30
2 assignments	2x10 = 20
Total marks	= 50

University examination pattern

Q I - 8 short type questions of 5 marks each, 2 from each module

Q II - 2 questions A and B of 15marks each from module I with choice to answer any one

Q III - 2 questions A and B of 15marks each from module II with choice to answer any one

Q IV - 2 questions A and B of 15marks each from module III with choice to answer any one

Q V - 2 questions A and B of 15marks each from module IV with choice to answer any one

ME04 603 : METAL CASTING & JOINING

3 hours lecture and 1 hour tutorial per week

Module I (10 hours)

Introduction - solidification of metals - mechanism of solidification - solidification with predominant interface resistance - solidification with constant surface temperature - solidification with predominant resistance in mould and solidified metal - flow of molten metal in moulds - furnaces and melting practices - patterns - pattern allowance - design considerations - shrinkage and machining allowance - foundries

Module II (14 hours)

Casting processes - comparison - sand casting - shell moulding - silicate bonded sand process (CO2 process) - expended polystyrene process - plaster mould casting - ceramic mould casting - investment casting - permanent mould casting - slush casting - pressure casting - die casting - centrifugal casting - squeeze casting - semisolid casting (rheocasting, thixoforming) - casting techniques for single crystal components - rapid solidification - residual stress - defects - inspection of castings - casting design - gating system design - risering - casting alloys - economics of casting - design rules for castings - case studies with specific examples of sand cast and permanent mould cast parts

Module III (16 hours)

Classification - filler materials - consumable electrodes - liquid state - chemical - arc - resistance - electrical characteristics of the arc - analysis of metal transfer - free flight and short-circuiting metal transfer - equations for heat flow in welding - equations for temperature distribution in the Heat Affected Zone-Gas-Metal reactions - sensitivity to hydrogen porosity - weld pool solidification - contraction and residual stress crack sensitivity - dilution and uniformity of the weld deposit - solid state - liquid-solid state - process: OFW - SMAW - SAW- GMAW - FCAW - GTAW - PAW - ESW - EGW - RW - RSEW - HFRW - RPW - FW - SW - PEW - FOW - CW - USW - FRW - EXW - TW - EBW - LBW - DFW

Module IV (12 hours)

The metallurgy of welding - metallurgy of weld metal and HAZ for carbon steels, ferritic and high alloy steels, austenitic and high alloy steels non-ferrous metals (Aluminium and its alloys, Copper and its alloys, Magnesium and its alloys) - weld quality - weldability - testing welded joints - welding design and process selection - brazing, soldering, adhesive bonding and mechanical joining processes - joining plastics - surface energy and contact angle - capillary action in brazing and soldering - residual stress and stress concentration factors in adhesive bonding

Text books

Flemings M.C., “Solidification Processing”, McGraw Hill

Serope Kalpakjian, Manufacturing Engineering & Technology, Addison Wesley

Heine R.W., Loper C.R. Jr. & Rosenthal P.C., Principles of Metal Casting, Tata McGraw Hill

American Welding Society, Welding Hand Book

Doyle L.E., Manufacturing Processes and Materials for Engineers, Prentice Hall of India

Metals HandBook- Vol.5., Welding Institute of Metals

Lancaster J.F., “The Metallaurgy of Welding, Brazing and Soldering”, George Allen & Unwin Ltd.

Sessional work assessment

2 tests	2x15 = 30
2 assignments	2x10 = 20
Total marks	= 50

University examination pattern

Q I - 8 short type questions of 5 marks each, 2 from each module

Q II - 2 questions A and B of 15marks each from module I with choice to answer any one

Q III - 2 questions A and B of 15marks each from module II with choice to answer any one

Q IV - 2 questions A and B of 15marks each from module III with choice to answer any one

Q V - 2 questions A and B of 15marks each from module IV with choice to answer any one

ME04 604 : MECHATRONICS

3 hours lecture and 1 hour tutorial per week

Module I (11 hours)

Introduction to mechatronics - sensors and transducers - signal conditioning - pneumatic and hydraulic systems - mechanical and electrical systems

Module II (11 hours)

System modelling - mathematical models - mechanical, electrical, fluid and thermal system building blocks - system models - dynamic response of systems - first and second order systems - modelling dynamic systems - system transfer functions - frequency response - stability

Module III (15 hours)

Closed loop controllers - continuous and discrete processes - proportional, derivative and integral controls - PID controller - digital controllers - controller tuning - adaptive control

Module IV (15 hours)

Micro controllers and microprocessors - digital logic circuits - micro controller architecture and programming - programmable logic controllers

Text book

Bolton W., Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, Addison Wesley Longman Limited

Reference books

Dorf R.C. & Bishop R.H., Modern Control Systems, Addison Wesley

Krishna Kant, Computer Based Industrial Control, Prentice Hall of Indian Private Limited

HMT Limited, Mechatronics, Tata McGraw Hill Publishing Company Limited

Herbert Taub & Donald Schilling, Digital Integrated Electronics, McGraw Hill International Editions

Sessional work assessment

Test	2x15 = 30
Assignment	2x10 = 20
Total marks	= 50

University examination pattern

Q I - 8 short type questions of 5 marks each, 2 from each module

Q II - 2 questions A and B of 15marks each from module I with choice to answer any one

Q III - 2 questions A and B of 15marks each from module II with choice to answer any one

Q IV - 2 questions A and B of 15marks each from module III with choice to answer any one

Q V - 2 questions A and B of 15marks each from module IV with choice to answer any one

ME04 605 : OPERATIONS RESEARCH

3 hours lecture and 1 hour tutorial per week

Module I: Linear algebra (13 hours)

Vectors - vector space and Euclidean space - vector operations - matrix operations - unit vector - sum vector - linear dependence - bases - spanning set - rank - simultaneous equations - basic solutions - point sets - lines and hyper planes - linear inequalities - convex sets - extreme points - fundamental theorem of linear programming

Module II: Linear programming (13 hours)

Statement of the LP problem - slack and surplus variables - basic feasible solutions - reduction of a feasible solution to basic feasible solution - artificial variables - optimality conditions - unbounded solutions - Charnes' M method - two phase method - degeneracy - duality

Module III: Transportation, assignment and game problems (13 hours)

Transportation problem - coefficient matrix and its properties - basic set of column vectors - linear combination of basic vectors - tableau format - stepping stone algorithm - UV method - inequality constraints - degeneracy in transportation problems - assignment problem as a maximally degenerate transportation problem - Köning's method - rectangular zero sum games - von Neuman's theorem - saddle points - pure and mixed strategies - formulation of the primal and dual LP problem for fixed strategies - dominance - graphical solutions

Module IV: Queuing theory (13 hours)

Basic structure of queuing models - exponential and Poisson distributions - birth and death processes - queuing models based on Poisson inputs and exponential service times - basic model with constant arrival rate and service rate - finite queue - limited source queue models involving non-exponential distributions - single service model with Poisson arrival and any service time distribution - Poisson arrival with constant service time - Poisson arrival and Erlang service times - priority disciplines - dynamic programming - Bellman's principle of optimality - formulation and solution of simple problems

Text books

Hadley G., Linear Programming, Addison Wesley

Hillier & Liberman, Operations Research, Holden Day Inc.

Ravindran, Solberg & Phillips, Operations Research, John Wiley

Reference books

Saskieni, Yaspen & Friedman, Operations Research: Methods and Problems, Wiley Toppan

Wagner, Principles of Operations Research, Prentice Hall of India

Sessional work assessment

3 Tests	2 x 15 = 30
2 Assignments	2 x 10 = 20
Total marks	= 50

University examination pattern

Q I - 8 short type questions of 5 marks each, 2 from each module

Q II - 2 questions A and B of 15marks each from module I with choice to answer any one

Q III - 2 questions A and B of 15marks each from module II with choice to answer any one

Q IV - 2 questions A and B of 15marks each from module III with choice to answer any one

Q V - 2 questions A and B of 15marks each from module IV with choice to answer any one

ME04 606 : DYNAMICS OF MACHINERY
3 hours lectures and 1 hour tutorial per week

Module I (13 hours)
Force analysis of machinery - static and dynamic force analysis of plane motion mechanisms - graphical method - principle of superposition - matrix methods - method of virtual work - complex number method – Force Analysis of Spur- Helical - Bevel and Worm gearing

Module II (13 hours)
Flywheel analysis - balancing - static and dynamic balancing - balancing of masses rotating in several planes - balancing of reciprocating masses - balancing of multicylinder engines, V Engines - balancing machines. Gyroscope.

Module III (13 hours)
Introduction to vibrations – Free and Forced vibrations of single degree freedom system – Energy Method - Damped vibrations – Coulomb damping - Logarithmic decrement – Vibration Isolation – Structural Damping - Transverse vibrations - support excitation - whirling of shafts – torsional vibrations – inertia effect of mass of shaft – torsionally equivalent systems – two rotor systems – three rotor systems.

Module IV (13 hours)
Two degree of freedom systems - coordinate transformations - coupling - natural coordinates - beat phenomenon - undamped vibration absorbers. Vibration of continuous systems - exact methods - boundary value problem - Eigenvalue problem - axial vibration of rods - bending vibration of bars. Introduction to nonlinear vibration vibration measurements. accelerometer – seismometer.

Text books
1. Shigley J.E. & Uicker J.J. Jr., Theory of Machines and Mechanisms, McGraw Hill
2. A Ghosh & Asok Kumar Malik, Theory of Mechanisms and Machines.
3. Thompson W T , Theory of Vibrations with Applications , Prentice Hall of India.

Reference books
1. Hollowenko, Dynamics of Machinery, McGraw Hill, Modules
2. Rao. S. S , Mechanical Vibrations, Pearson Education.

Sessional work assessment

2 Tests	2x15	= 30
2 Assignments		= 20
Total marks		= 50

Note: Computer based assignments are to be included.

University examination pattern

Q I - 8 short type questions of 5 marks each, 2 from each module

Q II - 2 questions A and B of 15marks each from module I with choice to answer any one

Q III - 2 questions A and B of 15marks each from module II with choice to answer any one

Q IV - 2 questions A and B of 15marks each from module III with choice to answer any one

Q V - 2 questions A and B of 15marks each from module IV with choice to answer any one

ME04 607(P) : MINI PROJECT

3 hours per week

The project work can be a design project, experimental fabrication project or software development project on any of the topics of mechanical engineering interest - it can be allotted as a group project with groups consisting of three or four students

The assessment of all the mini projects should be done by a committee consisting of three or four faculty members specialised in the various fields of mechanical engineering - the students will present their project work before the committee - the relative gradings and group average marks for the various projects will be fixed by the committee - the guides will award the marks for the individual students in the project maintaining the group average - each group will prepare the project report and submit to the department through the guide - the head of the department will certify the copies and keep them in the departmental library

Sessional work assessment

Presentation = 30

Report = 20

Total marks = 50

SEVENTH SEMESTER

Code	Subject	Hours/Week			Sessional Marks	University Examination	
		L	T	P/D		Hrs	Marks
ME04 701	Power Plant Engineering	3	1	-	50	3	100
ME04 702	Design of Machine Elements&CAD	3	1	-	50	3	100
ME04 703	Gas Dynamics and Jet Propulsion	3	1	-	50	3	100
ME04 704	Computer Integrated Manufacturing	3	1	-	50	3	100
ME04 705	Elective I	3	1	-	50	3	100
ME04 706(P)	Thermal Engineering Lab II	-	-	3	50	3	100
ME2K 707(P)	Seminar	-	-	3	50	-	-
ME2K 708(P)	Project	-	-	4	50	-	-
TOTAL		15	5	10	400	-	600

ME04 701 : POWER PLANT ENGINEERING

3 hours lecture & 1 hour tutorial per week

Module I (13 hours)

Analysis of steam power cycles – Rankine, Reheat and regenerative cycles – Open and close feed water heaters – Deaerator – Cogeneration – combined gas power cycles – layout of steam, diesel and gas turbine power plants.

Module II (13 hours)

Steam generators – fire tube and water tube boilers – Lancashire, Babcox and Wilcox boilers – Mounting and accessories – Modern high pressure boilers – fuel handling and burning systems – dust and ash handling systems – combustion equipments- over feed and under feed stockers – traveling grate and spreader stocker – pulverized coal burners – cyclone furnace – fluidized bed combustion.

Module III (13 hours)

Steam nozzles – mass flow rate – condition for maximum discharge – throat area – effect of friction – super saturated flow – effect of back pressure.

Steam turbines – classification – velocity diagram – efficiencies – turbine performance and governing.

Module IV (13 hours)

Condensers , cooling towers, classification, selection and modeling – nuclear power plants – reactors – classification – components – layout of simple plants – nuclear power plant safety and waste disposal.

Power plant economics – estimation of load – load curve – load factor – diversity factor – capacity factor – use factor – selection of units – number and size – scheduling operations – cost of energy – depreciation and replacement.

Text book

1. R.K. Rajput, A Text Book of Power Plant Engineering, Laxmi Publications(P) Ltd

2. P.K.Nag- A Textbook on Power Plant Engineering, Tata Mc Graw Hill

Reference books

1 Vopat & Scrotski, Power Station Engineering and Economy, Tata McGraw Hill

2 E1 Wakil, Power Plant Engineering, McGraw Hill

3 Morse, Power Plant Engineering, Van Nostrand Co.

4 Lee J.F., Power Station Engineering and Economy, Tata McGraw Hill

5 Bacon, Engineering Thermodynamics, Butterworth

6 Robert Loftness, Nuclear Power Plants, McGraw Hill

Sessional work assessment

Two Tests = 30

Two Assignments = 20

Total marks = 50

University examination pattern

Q I - 8 short type questions of 5 marks each, 2 from each module

Q II - 2 questions A and B of 15marks each from module I with choice to answer any one

Q III - 2 questions A and B of 15marks each from module II with choice to answer any one

Q IV - 2 questions A and B of 15marks each from module III with choice to answer any one

Q V - 2 questions A and B of 15marks each from module IV with choice to answer any one

ME04 702 : DESIGN OF MACHINE ELEMENTS & CAD

3 hours lecture & 1 hour tutorial per week

Module I (13 hours)

Design of clutches & brakes - belts and chain drives - friction clutches and brakes - uniform pressure and uniform wear assumptions - design of disc and cone types of clutches and brakes - design of external contracting and internal expanding elements - band type clutches and brakes - centrifugal clutches - belt and chain drives of common types - design of flat and V belt drives - selection of roller chains

Module II (13 hours)

Design of gears - spur, helical, bevel and worm gears - tooth loads - gear materials - design stresses -basic tooth stresses - stress concentration - service factor - velocity factor - bending strength of gear teeth -

Buckingham's equation for dynamic load - surface strength and durability - heat dissipation - design for strength and wear

Module III (13 hours)

Lubrication & journal bearing design - types of lubrication and lubricants - viscosity - journal bearing with perfect lubrication - hydrodynamic theory - design considerations - heat balance - journal bearing design - rolling contact bearings - bearing types - bearing life - static and dynamic capacity - selection of bearings with axial and radial loads - selection of tapered roller bearings - lubrication; seals, shaft, housing and mounting details

Module IV (13 hours)

Over view of CAD systems : Conventional and computer aided design processes-advantages and disadvantages – subsystems of CAD – CAD hardwares and softwares – analytical and graphical packages – CAD work stations , networking of CAD systems.

Computer aided Drafting : Automated 2D – drafting basics , functions, attributes, layers, dimensioning text styles – dragging and rubber banding – clipping – mechanical assembly – bill of material generation – mass property calculations.

Text book

Joseph Edward Shigley, Mechanical Engineering Design, McGraw Hill Book Company

Reference books

1 Siegel, Maleev & Hartman, Mechanical Design of Machines, International Book Company

Phelan R. M., Fundamentals of Mechanical Design, Tata McGraw Hill Publishing Co. Ltd.

Doughtie V. L.& Vallance A.V., Design of Machine Elements, McGraw Hill Book Company

Juvinall R.C. & Marshek K.M., Fundamentals of Machine Component Design, Second Edition, John Wiley & Sons

James G. Bralla, Handbook of Product Design for Manufacture, McGraw Hill Book Company

Data hand books (allowed for reference during examinations)

Prof. Narayana Iyengar B. R. & Dr Lingaiah K., Machine Design Data Handbook

P.S.G., Tech., Machine Design Data Handbook

Radhakrishnan P. and Kothandaraman C. P., Computer Graphics and Design, Dhanpat Rai and sons, 1997.

Sessional work assessment

2 tests	2x15 = 30
2 Design and drawing assignments	2x10 = 20
Total marks	= 50

University examination pattern

Q I - 8 short type questions of 5 marks each, 2 from each module

Q II - 2 questions A and B of 15marks each from module I with choice to answer any one

Q III - 2 questions A and B of 15marks each from module II with choice to answer any one

Q IV - 2 questions A and B of 15marks each from module III with choice to answer any one

Q V - 2 questions A and B of 15marks each from module IV with choice to answer any one

ME04 703: GAS DYNAMICS AND JET PROPULSION

3 hours lecture and 1 hour tutorial per week

Module I (13 hours)

Basic equations of fluid flow – Reynold's transport equation – integral and differential formulations – integral form of the equation of continuity- momentum and energy equations – differential form of these equations – Euler's equation and Bernoulli's equation for compressible flow.

Introduction to compressible flows – aerostatics – variation of pressure and density with altitude in troposphere and stratosphere. Fields of compressible flow – subsonic and super sonic flow – Mach angle and Mach cone – Karman's rule for super sonic flows – equations for acoustic speed.

Module II (13 hours)

Isentropic flow through duct – one dimensional approximation, stagnation quantities – isentropic relations – criterion for acceleration and deceleration – operation of converging and converging–diverging nozzle under varying pressure ratio- mass flow relations – performance of real nozzle.

Adiabatic flow with friction - Fanno lines and fanno flow relations – effect of friction on properties – choking due to friction.

Module III (13 hours)

Normal shocks in one dimensional flow – occurrence of shocks – analysis of normal shocks – Prandtl-Meyer relation – Rankine-Hugonit equation – equation for pressure ration and temperature ratio and entropy change across a normal shock – oblique shock relations - θ β μ relations – shock polar diagram – frictionless flow with heat transfer - Rayleigh lines - effect of heat addition on flow properties – thermal chocking – isothermal flows.

Module IV (13 hours)

Introduction to air breathing engines – working of turbo jet, turbo prop, ram jet and pulse jet engines – performance characteristics of turbo jet and turbo prop engines – rocket engines – solid propellant and liquid propellant rockets – advantages and disadvantages – equations for thrust , thrust power and propulsive efficiency of air breathing and rocket engines.

Text books

Shapiro A H, Dynamics and Thermodynamics of Compressible Fluid Flow , Ronald Press.

References

Zuckrow M J & Holfman D H, Gas Dynamics, McGraw Hill

Oosthuizen & Naylor, Compressible Fluid Flow , McGraw Hill

Rathakrishnan E, Gas Dynamics, Prentice Hall India

Michel A Saad, Compressible Fluid Flow, Prentice Hall, New Jersey

Yahya S M, Compressible Fluid Flow ,New Age International Pvt Ltd.,

Sessional work assessment

Two Tests = 30

Two Assignments = 20

Total marks = 50

University examination pattern

Q I - 8 short type questions of 5 marks each, 2 from each module

Q II - 2 questions A and B of 15marks each from module I with choice to answer any one

Q III - 2 questions A and B of 15marks each from module II with choice to answer any one

Q IV - 2 questions A and B of 15marks each from module III with choice to answer any one

Q V - 2 questions A and B of 15marks each from module IV with choice to answer any one

ME04 704 Computer Integrated Manufacturing

(3 hours lecture and 1 hour tutorial per week)

Module I (12 hours)

Introduction – Fundamentals of numerical control- Advantages of NC systems – classification of NC systems – point to point and contouring systems – NC and CNC – Incremental and absolute systems – open loop and closed loop systems – Features of NC machine tools – Fundamentals of machining – Design consideration of NC machine tools – methods of improving machine accuracy and productivity – special tool holders.

Module II (15 hours)

NC part programming - manual programming – tape formats – tab sequential – fixed block word address and variable block formats – part programming examples – point to point programming and contour programming computer aided programming concepts – post processor – program languages – APT – programming – part programming examples

Module III (15 hours)

Controls in CIM – programmable logic controllers – components of PLC – PLC operating cycle – Programming of PLC- Material handling in CIM- AGV- Vehicle guidance – vehicle management and safety – automated storage systems – ASRS- components and operation – features of ASRS – Automatic data capture – barcode technology – magnetic strips – optical character recognition – group technology – part families- part classifications and coding – features of Opitz classification and multi class coding system

Mode IV (12 hours)

Flexible manufacturing system – types of FMS -components of FMS – FMS work stations – material handling and storage systems – FMS layout configurations – computer control systems in FMS – applications and benefits of FMS – industrial robotics – robot anatomy – configurations – joints- drive systems – robot control systems – end effectors sensors in robots – industrial robots applications – robot programming-on line and off line programming

Textbooks

1.Yoram Koran; “Computer control of manufacturing systems”; Mc Graw -Hill international book Company

2 Mickell .P.Grooer ; “Automation, Production Systems and Computer Integrated Manufacturing”; Pearson Education

References

H.M.T, Mechatronics, Tata Mc Graw Hill

Groover M.P, Industrial Robotics- Technology, Programming and Applications- Mc Graw Hill.

ELECTIVE I

ME04 705A Finite Element Methods

ME04 705B Tool engineering & design

ME04 705C Inventory and Supply Chain Management

ME04 705D Design of Heat Transfer Equipments

ME04 705E System simulation & modelling

ME04 705F Software Engineering

ME04 705A : FINITE ELEMENT METHODS

3 hours lecture and 1 hour practical per week

Module I (13 hours)

Linear vector spaces - linear transformations and functionals - linear, bilinear and quadratic forms - theory of normed spaces - theory of inner product spaces - concepts from variational calculus - variational methods of approximation - Ritz method - weighted residual method - Galerkin method - subdomain method - collocation method

Module II (11 hours)

Finite element analysis of one dimensional problems - procedure - one dimensional elements and interpolation functions - analysis of one dimensional second and fourth order equations - approximation errors in the finite element method - computer implementation

Module III (15 hours)

Finite element analysis of two dimensional problems - two dimensional elements and interpolation functions - second order equations involving a scalar valued function - comments on mesh generation and composition of boundary conditions - analysis of plane elasticity and incompressible fluid flow problems - time dependent problems (transient heat transfer) - isoparametric elements and numerical integration

Module IV (13 hours)

Alternative formulations - least square formulation - mixed formulation - Eigenvalue problems - nonlinear problems - three dimensional elements and interpolation functions - formulation of three dimensional problems (two and three dimensional Navier-Stokes equations - three dimensional heat transfer equations)

Text books

Reddy J.N., An Introduction to the Finite Element Method, McGraw Hill International Edition

Reddy J.N., Applied Functional Analysis and Variational Methods in Engineering, McGraw Hill, International Edition

Reference books

Huebner K.H., The Finite Element Method for Engineers, John Wiley

Zenkiewicz O., The Finite Element Method, McGraw Hill International Edition

Sessional work assessment

3 Tests	2 x 15 = 30
2 Assignments	2 x 10 = 20
Total marks	= 50

University examination pattern

Q I - 8 short type questions of 5 marks each, 2 from each module

Q II - 2 questions A and B of 15marks each from module I with choice to answer any one

Q III - 2 questions A and B of 15marks each from module II with choice to answer any one

Q IV - 2 questions A and B of 15marks each from module III with choice to answer any one

Q V - 2 questions A and B of 15marks each from module IV with choice to answer any one

ME04 705B : TOOL ENGINEERING & DESIGN

3 hours of lecture and 1 hour of tutorial per week

Module I: Design of chips forming tools (13 hours)

Single point tools - tool geometry - tool materials - milling cutters - drills & reamers - grinding wheels - tipped tools - design of tool holders & boring bars - vibration damping of boring bars - form tools - influence of cutting parameters on cutting force and power - cutting power estimation in turning, milling & drilling

Module II: Press working tools (13 hours)

Power presses - die cutting operations - centre of pressure - punch & die size and press tonnage calculations - scrap - strip layout - compound and progressive dies - die design for simple components - drawing dies - blank development - press tonnage estimation - blank holding pressure - multiple draws - draw dies for simple shells

Module III: Design of fixture (13 hours)

Elements of fixture - standard work holding devices - principles of location & clamping - plain & concentric location - clamping elements - quick acting clamps - design & sketching of fixtures for milling of simple components

Module IV: Design of jigs (13 hours)

Jigs for drilling & reaming - types of jigs - guide bushings - indexing jigs - design & sketching of Jigs for simple jobs

Reference books

Bhattacharyya A., "Metal Cutting Theory & Practice", Central Book Publishers

ASTME, "Fundamentals of Tools Design", Prentice Hall

Wilson F.W., "Hand Book of Fixture Design", McGraw Hill

Lecain D. & Goold, "Tool Design", Tata McGraw Hill

Rodin P., "Design & Production of Metal Cutting Tools", MIR Publishers

HMT, "Production Technology", Tata McGraw Hill

Sessional work assessment

Two tests = 30

Two assignments = 20

Total marks = 50

University examination pattern

Q I - 8 short type questions of 5 marks each, 2 from each module

Q II - 2 questions A and B of 15marks each from module I with choice to answer any one

Q III - 2 questions A and B of 15marks each from module II with choice to answer any one

Q IV - 2 questions A and B of 15marks each from module III with choice to answer any one

Q V - 2 questions A and B of 15marks each from module IV with choice to answer any one

ME04 705C : INVENTORY & SUPPLY CHAIN MANAGEMENT

3 hours lecture & 1 hour tutorial per week

Module I (12 hours)

Supply chain management (SCM) - concept of logistics and SCM - decision phases - design, planning and operation - decision areas - type of supply chain views - flows in supply chain - supply chain and competitive performance - performance measures for SCM - strategic fit - drivers of supply chain

Module II (12 hours)

Sourcing and procurement - sourcing - factors in source selection - vendor rating - qualitative and quantitative methods - purchasing - objectives and procedure - purchasing systems - tender method - computer based systems/EDI - inventory concept - functions of inventory - selective inventory control techniques - structure of inventory problem - costs associated with materials management - relevant costs

Module III (14 hours)

Independent demand items - probabilistic - single order quantities - payoff matrix - incremental analysis - mathematical formulation of discrete and continuous cases - independent demand items - deterministic and dynamic - deterministic inventory models without and with backordering - sensitivity analysis - quantity discount - all units and incremental discounts

Module IV (14 hours)

Independent demand items - probabilistic and dynamic inventory models - Q and P system models - dependent demand items - deterministic models - lot sizing models - lot by lot - EOQ - part period balancing - wagner-whitin method - concept of just-in-time - kanban - introduction to distribution requirement planning

Text books

Dobler D.W. & Burt D.N., Purchasing and Supply Management: Text and Cases, Tata McGraw Hill Publishing Company Limited

Tersine R.J., Principles of Inventory and Materials Management, Prentice-Hall Inc

Starr M.K. & Miller D.W., Inventory Control: Theory and Practice, Prentice Hall of India

Chopra S. & Meindl P., Supply Chain Management: Strategy, Planning, and Operation, Pearson Education Asia

Reference books

Christopher M., Logistics and Supply Chain Management, Pitman Publishing Company

John Mortimer (Editor), Logistics in Manufacturing: An IFS Executive Briefing, IFS Publications, U.K. & Springer-Verlag

Narasimhan S.L., Mcleavy D.W. & Billington P.J., Production Planning and Inventory Control, Prentice Hall of India

Raghuram G. & Rangaraj N., Logistics and Supply Chain Management: Cases and Concepts, Macmillan India Limited

Sessional work assessment

2 test	2 x 15	= 30
2 Assignment		= 20
Total marks		= 50

University examination pattern

Q I - 8 short type questions of 5 marks each, 2 from each module

Q II - 2 questions A and B of 15marks each from module I with choice to answer any one

Q III - 2 questions A and B of 15marks each from module II with choice to answer any one

Q IV - 2 questions A and B of 15marks each from module III with choice to answer any one

Q V - 2 questions A and B of 15marks each from module IV with choice to answer any one

ME04 705(D) : DESIGN OF HEAT TRANSFER EQUIPMENTS

3 hours lecture and 1 hour tutorial per week

Module I (13 hours)

Introduction to heat exchanger - classification – selection. Heat transfer and fluid flow theory – determination of overall heat transfer coefficient – viscosity correction factor – heat transfer coefficient and pressure loss correlations – mean temperature difference – application to design.

Module II (13 hours)

Design of double pipe heat exchanger – shell and tube heat exchanger – construction and thermal features – thermal design – Kern method – Bell-Delawae method – flow stream – analysis method – approximate sizing.

Module III (13 hours)

Design of air cooled heat exchanger – compact heat exchanger – plate and fin heat exchanger- plate and frame heat exchanger – periodic flow regenerators.

Module IV (13 hours)

Heat pipes – applications - fluid selection - Wick selection – compatibility – limitations – design of circular heat pipes.

Text book

Hewitt, Shires & Bott , Processes Heat Transfer , CRC Press

Reference

Saunders, Heat Exchangers – Selection, Design and Construction, Longman Scientific & Technical , UK

R K Shah, Fundamentals of Heat Exchanger Design, John Wiley & Sons.

Dunn & Rey, Heat Pipe Theory and Practice, Pergamon Press.

Sessional work assessment

2 tests	2x15 = 30
2 Design and drawing assignments	
(one for Jig design and other for fixture design)	2x10 = 20
Total marks	= 50

University examination pattern

Q I - 8 short type questions of 5 marks each, 2 from each module

Q II - 2 questions A and B of 15marks each from module I with choice to answer any one

Q III - 2 questions A and B of 15marks each from module II with choice to answer any one

Q IV - 2 questions A and B of 15marks each from module III with choice to answer any one

Q V - 2 questions A and B of 15marks each from module IV with choice to answer any one

ME04 705E : SYSTEM SIMULATION & MODELLING

3 hours of lecture and 1 hour of tutorial per week

Module I (14 hours)

System concepts - systems and system environment - components of a system - discrete and continuous systems - types of system study - system analysis - system design and system postulation - system modelling

- types of models - system simulation - steps in a simulation study - comparison of simulation and analytical models - Monte Carlo simulation - examples of simulation of single server, single queue systems and simple inventory systems - concepts in discrete event system simulation - event scheduling/time advance algorithm - modelling world views

Module II (12 hours)

Random number generation - techniques for generating random numbers - linear congruential method - tests for random numbers - frequency tests - the Kolmogorov-Smirnov test and the Chi-square test - random variate generation - inverse transformation method - exponential, uniform and empirical discrete and empirical continuous distributions - input modelling for simulation - data collection - identifying the distribution using histograms - parameter estimation - Chi-square goodness of fit test

Module III (13 hours)

Verification and validation of simulation models - verification of simulation models - calibration and validation of models - face validity - validation of model assumptions and validating input-output transformations - output analysis for a single model - types of simulations with respect to output analysis - measures of performance and their estimation - output analysis for terminating simulations - confidence interval estimation for a fixed number of replication - confidence intervals with specified precision - output analysis for steady-state simulations - initialization bias - replication method - sample size determination for a specified precision - batch means method

Module IV (13 hours)

Simulation modelling and analysis of manufacturing systems - objectives - performance measures - issues in simulation of manufacturing systems - simulation of simple job shop manufacturing systems - Introduction to simulation software for manufacturing applications - salient features of simulation languages such as general purpose simulation system (GPSS) and simulation language for alternative modelling (SLAM) - salient features of simulators such as WITNESS and arena

Text book

Banks J., Carson J.S. & Nelson B.L., Discrete-Event System Simulation, Prentice Hall of India Private Limited

Reference books

Askin R.G. & Standridge C.R., Modelling and Analysis of Manufacturing Systems, John Wiley

Deo N., System Simulation with Digital Computer, Prentice-Hall of India Private Limited

Gordon G., System Simulation, Prentice Hall of India Private Limited

Law A.W. & Kelton W.D., Simulation Modelling and Analysis, Third Edition, McGraw Hill International Editions

Kelton W.D., Sadowski R.P. & Sadowski D.A., Simulation with ARENA, WCB/McGraw Hill International Editions

Sessional work assessment

Two tests	= 30
Two assignments	= 20
Total marks	= 50

ME04 705 F : SOFTWARE ENGINEERING

3 hours lecture and 1 hour tutorial per week

Module I (13 hours)

Introduction - FAQs about software engineering - professional and ethical responsibility - system modelling - system engineering process - the software process - life cycle models - iteration - specification - design and implementation - validation - evolution - automated process support - software requirements - functional and non-functional requirements - user requirements - system requirements - SRS - requirements engineering processes - feasibility studies - elicitation and analysis - validation - management - system models - context models - behaviour models - data models - object models - CASE workbenches

Module II (13 hours)

Software prototyping - prototyping in the software process - rapid prototyping techniques - formal specification - formal specification in the software process - interface specification - behaviour specification - architectural design - system structuring - control models - modular decomposition - domain-specific architectures - distributed systems architecture - object-oriented design - objects and classes - an object oriented design process case study - design evolution - real-time software design - system design - real time executives - design with reuse - component-based development - application families - design patterns - user interface design - design principles - user interaction - information presentation - user support - interface evaluation

Module III (13 hours)

Dependability - critical systems - availability and reliability - safety - security - critical systems specifications - critical system development - verification and validation - planning - software inspection - automated static analysis - clean room software development - software testing - defect testing - integration testing - object-oriented testing - testing workbenches - critical system validation - software evolution - legacy systems - software change - software maintenance - architectural evolution - software re-engineering - data re-engineering

Module IV (13 hours)

Software project management - project planning - scheduling - risk management - managing people - group working - choosing and keeping people - the people capability maturity model - software cost estimation - productivity estimation techniques - algorithmic cost modeling, project duration and staffing quality management - quality assurance and standards - quality planning - quality control - software measurement and metrics - process improvement - process and product quality - process analysis and modeling - process measurement - process CMM - configuration management - planning - change management - version and release management - system building - CASE tools for configuration management

Text book

Ian Sommerville, Software Engineering, Pearson Education Asia

Reference books

Pressman R.S., Software Engineering, McGraw Hill

Mall R., Fundamentals of Software Engineering, Prentice Hall of India

Behferooz A. & Hudson F.J., Software Engineering Fundamentals, Oxford University Press

Jalote P., An Integrated Approach to Software Engineering, Narosa

Sessional work assessment

Assignments	2x10 = 20
Tests	2x15 = 30
Total marks	= 50

ME04 706(P) : THERMAL ENGINEERING LAB II

3 hours per week

Study of systems and components of petrol and diesel engines

Study of automotive parts

Study of air compressors, blower and fan

Determination of viscosity, flash and fire points and calorific value of oils

Tests on internal combustion engines:

Determination of valve timing diagram of engines

Determination of various efficiencies - brake thermal efficiency, indicated thermal efficiency, mechanical efficiency and volumetric efficiency

Determination of friction power - retardation test and Morse test

Study of effect of cooling water and speed on engine performance

Heat balance test

Analysis of exhaust gas of internal combustion engines

Performance tests on air compressor and blower

Performance test on refrigeration plant

List of experiments in thermal engineering lab

(Based on test rigs available in Calicut REC)

Determination of viscosity of oils and its variation with temperature

Determination of flash and fire points of fuels

Determination of caloric value of fuels

Valve timing diagram on Ruston engine and kirloskar engine

Constant speed performance characteristics of ambassador engine

Constant speed performance characterists of comet engine

Constant speed performance characterists of Jawahar engine

Constant speed performance characteristics of Kirloskar (5hp) engine

Variable speed performance characteristics of Kirloskar (10hp) engine

Variable speed performance characteristics of ambassador engine

Variable speed performance characteristics of Honda engine

Morse test on ambassador engine

Retardation test on Jawahar engine

Retardation test on Anil engine

Cooling curve on Jawahar engine

Cooling curve on Coment engine

Cooling curve on Kirloskar (10hp) engine

Heat balance test on Jawahar engine

Heat balance test on Comet engine

Heat balance test on Kirloskar (10hp) engine

Exhaust gas analysis of Fiat engine

Performance test on Reciprocating Air Compressor

Performance test on Rotary Air Compressor

Performance test on Air Blower

Performance test on vapour compression refrigeration plant

ME04 707(P) SEMINAR (3 hours per week)

Individual students should be asked to choose a topic in any field of mechanical engineering, preferably from outside the B.Tech syllabus and give a seminar on that topic for about thirty minutes - a committee consisting of at least three faculty members (preferably specialised in different fields of mechanical engineering) should assess the 3 hours per week

presentation of the seminars and award the marks to the students - each student should be asked to submit two copies of a write up of his seminar talk - one copy should be returned to the student after duly certifying it by the chairman of the assessment committee and the other kept in the departmental library

Sessional work assessment

Presentation	= 30
Report	= 20
Total marks	= 50

ME04 708(P) : PROJECT

4 hours per week

The project work can be a design project - experimental project - computer oriented software project on any of the topics of mechanical engineering interest - it can be allotted as a group project consisting of a maximum number of five students - the topic of the project for any student should be different from his/her mini project

The assessment of all the projects should be done at the end of the seventh semester by a committee consisting of three or four faculty members specialised in the various fields of mechanical engineering - the students will present their project work before the committee - the complete project report is not expected at the end of the seventh semester - however a three-four page typed report based on the work done should be submitted by the students to the assessment committee - the project guides will award the marks for the individual students in a project maintaining the group average fixed by the assessment committee

Sessional work assessment

Presentation = 30

Report = 20

Total marks = 50

EIGTH SEMESTER

Code	Subject	Hours/Week			Sessional Marks	University Examination	
		L	T	P/D		Hrs	Marks
ME04 801	Refrigeration and Air Conditioning	3	1	-	50	3	100
ME04 802	Operations Management	3	1	-	50	3	100
ME04 803	Maintenance Engineering	3	1	-	50	3	100
ME04 804	Elective II	3	1		50	3	100
ME04 805	Elective III	3	1	-	50	3	100
ME04 806(P)	CAD/CAM Lab	-	-	3	50	3	100
ME04 807(P)	Project	-	-	7	100	-	-
ME04 808(P)	Viva Voce	-	-	-	-	-	100
TOTAL		15	5	10	400	-	700
Aggregate marks for 8 semesters = 8300					3000		5300

ME04 801 : REFRIGERATION AND AIRCONDITIONING

3 hours lecture and 1 hour tutorial per week

Module I (11 hours)

Principles of refrigeration-unit of refrigeration - capacity - coefficient of performance (COP) - refrigeration systems - Carnot refrigeration cycle - steam jet refrigeration - thermoelectric refrigeration - vortex tube - pulse tube - air refrigeration cycle - thermodynamic analysis of Bell-Coleman cycle

Module II (13 hours)

Vapour compression system - theoretical and practical cycles - simple and multipressure systems - thermodynamic analysis - vapour absorption system - principle of operation of aqua - ammonia and lithium bromide - water systems - electrolux system - comparison between vapour compression and absorption systems - refrigerants - thermodynamic, physical and chemical properties of refrigerants - selection criteria of refrigerants

Module III (12 hours)

System components - compressors - reciprocating compressors - single and multistage compressors - work of compression - effect of clearance - effect of intercooling - optimum pressure ratio - efficiencies - rotary compressors - screw type and vane type compressors - hermetic, semihermetic and open compressors - condensers - water cooled and air cooled condensers - evaporative condensers - expansion devices - capillary tube - constant pressure expansion valve - thermostatic expansion valve - float valves - evaporators - natural convection and forced convection coils - flooded evaporators - direct expansion coils

Module IV (16 hours)

Psychrometry - psychrometric properties and processes - determination of air entering conditioned space - air conditioning systems - summer, winter and year-round-year air conditioning systems - central and unitary systems - human comfort - comfort chart and limitations - effective temperature - factors governing effective

temperature - design considerations - cooling load calculation - various heat sources - solar load - equipment load - infiltration air load - duct heat gain - fan load - moisture gain through permeable walls and fresh air load - design of air conditioning systems - duct design - air distribution systems - heating systems - heat pump - noise and noise control

Text books

Stoecker, Refrigeration and Air Conditioning, Tata McGraw Hill

Jordan & Priester, Refrigeration and Air Conditioning, Prentice Hall

Arora, Refrigeration and Air Conditioning, Tata McGraw Hill

Reference books

Dossat, Refrigeration and Air Conditioning

Norman Harris, Modern Air Conditioning Practice, McGraw Hill

Sessional work assessment

Two tests	= 30
Two assignments	= 20
Total marks	= 50

University examination pattern

Q I - 8 short type questions of 5 marks each, 2 from each module

Q II - 2 questions A and B of 15marks each from module I with choice to answer any one

Q III - 2 questions A and B of 15marks each from module II with choice to answer any one

Q IV - 2 questions A and B of 15marks each from module III with choice to answer any one

Q V - 2 questions A and B of 15marks each from module IV with choice to answer any one

ME04 802 : OPERATIONS MANAGEMENT

3 hours lecture and 1 hour tutorial per week

Module I (14 hours)

Decision making - strategic and tactical decisions - strategy formulation - models of decision making - single stage decisions sunder risk - incremental analysis - multi stage decision making - decision trees - decision making under uncertainty - Baye's decision theory - equally likely - minimax - maximum likelihood - maximin criterion - network techniques - basic concepts - network construction - CPM and PERT networks - algorithm for critical path - slacks and their significance - crashing - network flow problems - the shortest route problem - minimal spanning tree problem - maximal flow in capacitated network

Module II (12 hours)

Inventory control - functions of inventories - structure of inventory problems - relevant costs - opposing costs - opportunity cost - selective control techniques - dynamic inventory models under certainty - sensitivity analysis - quantity discounts - introduction to dynamic inventory models under risk - Q and P system design

Module III (14 hours)

Production planning and control - scope and objectives - functions of PPC - product consumption cycle - product design and development - production planning - process planning - material requirement planning - forecasting - methods of forecasting - moving average method - single exponential smoothing - linear regression - linear forecaster - scheduling - objectives - performance measures - priority rules - single machine scheduling - job shop scheduling - 2 jobs N machines - flow shop scheduling - N jobs 2 machines - N jobs 3 machines scheduling

Module IV (12 hours)

Facilities planning and design - factors influencing location - plant layout - layout design procedures - systematic layout planning - computerised layout planning - construction algorithm ALDEP - improvement algorithm - greedy switch and steepest descent methods - CRAFT - introduction to line balancing methods - rank positional weight method

Text books

Riggs J.L., Economic Decision Models for Engineers and Managers, McGraw Hill International Students Edition

Weist & Levy, A Management Guide to PERT & CPM, Prentice Hall of India

Starr & Miller, Inventory Control - Theory & Practice, Prentice Hall of India

Samuel Eilon, Production Planning & Control, Universal Book Corporation

Francis & White, Facility Layout & Location, Prentice Hall Inc.

Reference books

Hillier & Lieberman, Introduction to Operations Research, Holden Day Inc.

Biegel, Production Control, Prentice Hall of India

James Moore, Plant Layout & Design, The Macmillan Company

Sessional work assessment

Two Tests = 30

Two Assignments = 20

Total marks = 50

University examination pattern

Q I - 8 short type questions of 5 marks each, 2 from each module

Q II - 2 questions A and B of 15marks each from module I with choice to answer any one

Q III - 2 questions A and B of 15marks each from module II with choice to answer any one

Q IV - 2 questions A and B of 15marks each from module III with choice to answer any one

Q V - 2 questions A and B of 15marks each from module IV with choice to answer any one

module IV with choice to answer any one

ME04 803 MAINTAINANCE ENGINEERING

(3 hours lectures and 1 hour tutorial per week)

MODULE I (12 Hours)

Basic concepts purpose and functions of maintenance- types of maintenance- condition monitoring– principles and method –Transducers for vibration measurement.

MODULE II (15 Hours)

Elementary problem diagrams – misalignment – unbalance – vibration monitoring and analysis – vibration analysis – proximity analysis – frequency analysis – spectral analysis – real time analysis vibration limits vibration severity criteria vibration severity charts – shock pulse analysis application to condition monitoring of ball and roller bearing s- vibration signature analysis.

MODULE III (13 Hours)

Ferrography – spectral oil analysis procedure – non destructive testing – liquid penetrant testing – radio graphic inspection – ultra sonic testing acoustic emission corrosion monitoring – resistance techniques – technique providing information on plant regarding corrosion monitoring

MODULE IV (14 Hours)

Reliability: Basic concepts – reliability , maintainability and availability – failure rate – mean time between failures – system reliability – reliability of series and parallel systems – reliability estimation using exponential distribution function.

Text book

1. L.S.Sreenath, Vibration spectrum analysis A practical approach: Steve Goldman Industrial Press Inc

Sessional work assessment

Two Tests = 30

Two Assignments = 20

Total marks = 50

University examination pattern

Q I - 8 short type questions of 5 marks each, 2 from each module

Q II - 2 questions A and B of 15marks each from module I with choice to answer any one

Q III - 2 questions A and B of 15marks each from module II with choice to answer any one

Q IV - 2 questions A and B of 15marks each from module III with choice to answer any one

Q V - 2 questions A and B of 15marks each from module IV with choice to answer any one

ELECTIVE (II)

ME04 804A Industrial Tribology

ME04 804B Quality Engineering Management

ME04 804C Composite Materials

ME04 804D Heating and Ventilating A/C System Design

ME04 804E Aerospace Engineering

ME04 804F Fracture Mechanics

ME04 804A : INDUSTRIAL TRIBOLOGY

3 hours lecture and 1 hour tutorial per week

Module I (13 Hours)

Introduction – viscosity and its temperature dependents – models of visco elastic materials – Navier Stoke's equations – derivation of Reynold's equation from Navier Stoke's equation – one dimensional journal bearing – infinitely long bearing – infinitely short bearing - one dimensional thrust bearing.

Module II (13 Hours)

Finite journal and thrust bearings – journal bearing work – axial and circumferential feeding – journal bearing solutions – centrally loaded partial bearings – axial groove bearings – non circular bearings – finite thrust bearings – step bearings.

Module III (13 Hours)

Hydrodynamic gas bearing – general equations – limiting characteristics – infinitely long slider bearings – parallel, plane, inclined, slider, step slider – finite slider bearings – infinitely long journal bearings – journal bearings with inertia considered – journal bearings with inertia neglected – finite journal bearings – perturbation and numerical solutions.

Module IV (13 Hours)

Friction and wear – mixed friction theory of sliding friction – boundary friction – extreme pressure lubrications – surface layer – extreme pressure additives – thick boundary film thickness – scuffing boundary friction – stick – slip- wear- adhesive wear – mild and sever wear – abrasive wear – fatigue and corrosive wear- delaminations – measurement of friction and wear.

References

1. B C Majumdar, Introductin to Tribology, A H Wheeler, Bangalore.
2. Pinkus and Sternilincht, Theory of hydrodynamic lubrication, John Wiley and Son, Newyork
3. D F Moore, Principle and Application of Tribology, Pergamon Press, Newyork
4. E Rabinnowizc, Friction & Wear of Metals , John Wiley & Sons , Newyork
5. K L Johnson, Contact Mechanics . Cambridge University Press.
6. T R Thomas, Rough Surfaces, Longman Inc.

Sessional work assessment

Two tests = 30

Two assignments = 20

Total marks = 50

University examination pattern

Q I - 8 short type questions of 5 marks each, 2 from each module

Q II - 2 questions A and B of 15marks each from module I with choice to answer any one

Q III - 2 questions A and B of 15marks each from module II with choice to answer any one

Q IV - 2 questions A and B of 15marks each from module III with choice to answer any one

Q V - 2 questions A and B of 15marks each from module IV with choice to answer any one

ME04 804 B : QUALITY ENGINEERING & MANAGEMENT

3 hours lecture and 1 hour of tutorial per week

Module I (10 hours)

Introduction to the concept of quality - quality control - quality assurance - quality management - quality and total quality - small q and big Q - concept of total quality management - TQM axioms - major contributions of deming, juran and crossby to quality management - enablers for total quality - strategic quality management

Module II (10 hours)

Quality costs - analysis of quality costs - loss function - taguchi methods - total quality tools - pareto chart - fishbone diagram - checksheet - histograms - scatter diagrams - run charts - flow diagram - survey - implementing - total quality - ISO 9000 certification - quality circles- motivation theories

Module III (10 hours)

Customer needs and product quality - market research - product design - quality function deployment - reliability - reliability goals - failure mode, effect, and criticality analysis - design for safety - error proofing design for manufacturability - manufacturing planning for quality - quality responsibilities on the factory floor - total employee involvement and empowerment - benchmarking - continuos improvement strategies - kaizen approach

Module IV (11 hours)

Statistical tools in quality - making predictions using the normal, poisson and binomial probability distributions - statistical process control - control charts for variables – $\bar{X}$, R , and σ charts - process capability indices - control charts for attributes - P, np, c and u charts

Module V (11 hours)

Acceptance sampling - lot by lot acceptance using single sampling by attributes - OC curve - average outgoing quality and the AOQL - double sampling - multiple and sequential sampling - dodge - romig sampling tables - ATI and AFI - introduction to life testing and reliability

Text books

Juran J.M., Gryna F.M., "Quality Planning and Analysis", Tata McGraw Hill Publishing Company

Grant E.L. & Leavenworth R.S., "Statistical Quality Control", McGraw Hill International Edition

Geoetsch D.L. & Davis S.B., "Introduction to Total Quality: Quality Management for Production, Processing and Services", Prentice Hall International, Inc.

Logothetis N., "Managing for Total Quality", Prentice Hall of India Private Limited

Bharat Wakhlu, "Total Quality", Wheeler Publishing

Sessional work assessment

Two tests = 30

Two assignments = 20

Total marks = 50

University examination pattern

Q I - 8 short type questions of 5 marks each, 2 from each module

Q II - 2 questions A and B of 15marks each from module I with choice to answer any one

Q III - 2 questions A and B of 15marks each from module II with choice to answer any one

Q IV - 2 questions A and B of 15marks each from module III with choice to answer any one

Q V - 2 questions A and B of 15marks each from module IV with choice to answer any one

ME04 804C : COMPOSITE MATERIALS
3 hours lecture and 1 hour tutorial per week

Module I (15 hours)

Introductin to composites natural composites (examples)- characteristics classifications – fibrous, flake, particulate composities, applications of PMC, CMC and MMC.

Module II (15 hours)
Manufacturing and testing methods – production of various fibres – matrix materials and surface treatments – fabrication of composites – fabrication of thermosetting resin matrix composites – fabrication of thermoplastic resin matrix composites/ short fibre composites – fabrication of metal matrix composites – fabrication of ceramic matrix composites – carbon-carbon composites.

Module III (15 hours)
Machining aspects of composites – experimental characterization of composites – uniaxial tension – compression and shear tests – determination of interlaminar and fracture toughness – damage identification through nondestrcuctive evaluation techniques - ultra sonic, acoustic emission and X-radiography.

Module IV (13 hours)
Mechanical behaviour of UD composites – longitudinal strength and stiffness – transverse strength and stiffness – failure modes analysis of laminated composites – strain-stress variation in a laminate – special laminates – symmetric laminates, unidirectional, cross-ply and angle-ply laminates Quasi-isotropic laminates. Determination of laminae stresses and strains.

References

1. Agarwal B D & Broutman L J, Analysis and Performance of Fiber Composites, John Wiley International.
2. Gibson R F, Principle of Composite Material Mechanics, McGraw Hill
3. Schwartz M M, Composite Materials Handbook, McGraw Hill. Inc.
4. Jones R M, Mechanics of Composite Materials, McGraw Hill. Inc
5. Tsai S W, Introduction to Composite Materials, Technomic Publishing Company.

Sessional work assessment

Two tests = 30

Two assignments = 20

Total marks = 50

University examination pattern

Q I - 8 short type questions of 5 marks each, 2 from each module

Q II - 2 questions A and B of 15marks each from module I with choice to answer any one

Q III - 2 questions A and B of 15marks each from module II with choice to answer any one

Q IV - 2 questions A and B of 15marks each from module III with choice to answer any one

Q V - 2 questions A and B of 15marks each from module IV with choice to answer any one

ME04 804 D: HEATING VENTILATING AND AIR CONDITIONING SYSTEM DESIGN

3 hours lecture and 1 hour tutorial per week

Module 1

Principles of refrigeration and psychrometry. Psychrometric properties and processes. Air conditioning systems and its applications – Psychrometric chart- various process-sensible cooling and heating-adeabate saturation- use &absorbent or adsorbent - Heating and humidification - cooling and dehumidification - mixing of air streams - use of psychrometric chart for air conditioning - various process - S.H.F, G..S.H.F, E.S.H.F Etc.

Module 2

Cooling and heating load calculation - selection of design temperatures - sources of heat load- heat transfer through structures - solar radiation - Infilteration and ventilation- Heat generation inside the conditioned space - heat storage, Diversity and stratification.

Module 3

Design of air conditioning system. Continuty equation, Bernoulli's equation, pressure losses, Duct design - pressure drop in ducts, pressure drop by graphical method- method of duct design- Arrangements of ducts, fan – design, thermal insulation

Module 4

Heating systems-warm air systems-hot water systems steam heating systems-panel and central heating systems-heat pump circuit. Applications- comfort air conditioning-effective temperature-thermal analysis of human body- Air conditioning systems- evaporate cooling- low humidity applications Automobile and Train car air conditioning.

Reference Books

1. C.P. Arora - Refrigeration and Air Conditioning.
2. Manohar Prasad - Refrigeration and Air Conditioning.
3. W.P. Jones - Air conditioning Engineering
4. Carriers Handbook system design of Air Conditioning
5. Refrigeration and Air conditioning - Richard. G. Jordan and Gayle B Priester.

Sessional work assessment

Two tests = 30

Two assignments = 20

Total marks = 50

University examination pattern

Q I - 8 short type questions of 5 marks each, 2 from each module

Q II - 2 questions A and B of 15marks each from module I with choice to answer any one

Q III - 2 questions A and B of 15marks each from module II with choice to answer any one

Q IV - 2 questions A and B of 15marks each from module III with choice to answer any one

Q V - 2 questions A and B of 15marks each from module IV with choice to answer any one

ME04 804E: AEROSPACE ENGINEERING
3 hours lecture and 1 hour tutorial per week

Module I (10 hours)
Equations for incompressible in viscid flows, fluid circulation and rotation, vorticity, Kelvin's theorem, velocity potential, stream function, equation of a stream line, complex potential, Blasius theorem for force and moment on bodies, elementary flow patterns and their superposition.

Module II (10 hours)
Flow past a cylinder, Magnus effect, Kutta condition, Vortex theory of lift, conformal transformation, the Jowkowski transformation, lift on arbitrary cylinder, aerodynamic center, pitching moment.

Module III (10 hours)
Aerofoild, low speed flows over aerofoils the vortex sheet, thin aerofoil theory, symmetric aerofoil, tear drop theory, Camber line at zero angle of attack, characteristics of thin aero foils, motion in three dimensions, flow past slender bodies.

Module IV (10 hours)
Finite wings, downwash and induced drag, Prandtl-Lachester theory, Biot-Savarat law, general series solution, Glauret method, Multhop's method, Horseshoe effects, ground effects, lineraised compressible flows in two dimensions, flow past a wavy wall, similarity rules, aerofoil in compressible flows.

Text Book.

1. John D Anderson Jr., Fundamentals of Aerodynamics , McGraw Hill

References

1. Kuethe and Chow, Foundations of aerodynamics – Wiley 1976
2. Katz and plotkin, Low speed aerodynamics, McGraw Hill 1990
3. Milne Thomson L M, Theoretical hydrodynamics, Mc Millen 1958
4. E L Houghton and A E Brock, Aerodynamics for engineering students, Edward Arnold (Publishers) Ltd.

Sessional work assessment

Two tests = 30

Two assignments = 20

Total marks = 50

University examination pattern

Q I - 8 short type questions of 5 marks each, 2 from each module

Q II - 2 questions A and B of 15marks each from module I with choice to answer any one

Q III - 2 questions A and B of 15marks each from module II with choice to answer any one

Q IV - 2 questions A and B of 15marks each from module III with choice to answer any one

Q V - 2 questions A and B of 15marks each from module IV with choice to answer any one

ME04 804F Fracture Mechanics

3 hours lecture and 1 hour tutorial per week

Module I (12 hours)
Introduction: Introduction to conventional approach and fracture mechanics – significance of defects in materials – brittle fracture experienced in the past – the effect of crack in a components – mechanism of fracture and crack growth – Griffith's energy balance approach – the three modes of cracking – initiation, propagation & closure of cracks.
Linear elastic fracture mechanics (LEFM) : Expressions for stresses and strains in the crack tip region – stress intensity factor (SIF) – strain energy release rate – critical stress intensity factor – principle of superposition – SIF solutions for practical problems such as wedged loads on cracked surface, edge cracks, fully embedded elliptical cracks.

Module II (13 hours)
Crack tip plasticity: the shape of plastic zone plastic zone shape and size for Mises yield criterion and Tresca yield criterion – Irwin plastic zone correction – the Dugdale approach – effective crack length.
Energy principle: Griffith's energy balance approach – energy release rate – criterion for crack growth - crack resistance – R curve.
Dynamics and crack arrest : Crack speed and kinetic energy – dynamic stress intensity and elastic energy release rate – dynamic fracture toughness – crack branching – crack arrest.

Module III (14 hours)
Elastic – Plastic Fracture Mechanics (EPFM) : Fracture beyond general yield – crack tip opening displacement (CTOD) – determination and use of CTOD – critical CTOD – J integral – tearing modulus – relation between J integral and CTOD.

Fatigue crack growth: Fatigue cracking criteria – crack growth and stress intensity factor – factors affecting crack growth – variable amplitude service loading – small cracks – fracture resistance of materials – effect of temperature, alloying, processing and anisotropy in the fracture resistance of materials.

Module IV (13 hours)
Application of fracture mechanics concept to design: Means to provide fail safety and damage tolerance – required information for fracture mechanics application and collection of available information – application to pressure vessel and pipelines – Leak before break criterion – material selection – use of fatigue crack growth parameters and its application to design.
Practical problems: Through cracks emanating from holes – corner cracks at homes – cracks approaching holes – fracture toughness of weldments – service failure analysis.

Text Book

1. Broek D. Elementary engineering fracture mechanics, Sijthoff & Noordhoff International publishers.

References:

1. Hellan K, Introduction to fracture mechanics, McGraw Hill Book company
2. Prashant Kumar, Elements of fracture mechanics, Wheeler publishing
3. Edwalds H L & Wanhill RJH, Fracture mechanics, Edward Arnold Edition.

Sessional work assessment

Two tests = 30

Two assignments = 20

Total marks = 50

University examination pattern

Q I - 8 short type questions of 5 marks each, 2 from each module

Q II - 2 questions A and B of 15marks each from module I with choice to answer any one

Q III - 2 questions A and B of 15marks each from module II with choice to answer any one

Q IV - 2 questions A and B of 15marks each from module III with choice to answer any one

Q V - 2 questions A and B of 15marks each from module IV with choice to answer any one

ELECTIVE (III)

ME04 805A To be published

ME04 805B Marketing Management

ME04 805C Manufacturing Process of Non-Metals

ME04 805D Computational Fluid Dynamics

ME04 805E Automobile Engineering

ME04 805F Design of Jigs and Fixtures

ME04 805B : MARKETING MANAGEMENT
3 hours lecture and 1 hour tutorial per week

Module I (12hours)
Introduction to marketing : Defining marketing for the twenty first century, marketing – scope, tasks, concept of market and marketing, company orientations towards the market place – production , product, selling, marketing, customer and societal marketing concepts.

Marketing environment : Controllable factors, identifying and responding to the major macro environment – uncontrollable factors – demographic, economic, natural technological, political- legal and social – cultural environment.

Module II (12 hours)

Market Oriented strategic planning – key areas, organizational levels, corporate and division strategic planning – corporate mission, strategic business units, The Boston consulting group approach, The general electric model, Planning new businesses – Growth – Intensive, integrative, diversification, Marketing mix – variables, marketing-mix strategy. Market-segmentation – levels, patterns, procedure, effectiveness. Market targeting – Evaluation, target market selection.

Module III (14 hours)

Marketing research – Need, scope – Marketing research process. Consumer behaviour – factors influencing buyer behaviour – Cultural, social personal, psychological factors. Defining customer value and satisfaction. Product life cycles – marketing strategies for different stages of product life cycle.

Module IV (hours)

Marketing communications – process – developing effective communications – Identification of the target audience, determination of communication objectives, Designing the message, select the communication channels, establishing the total marketing communications budget – Deciding on the marketing communications mix – promotional tools an over view – advertising, sales promotion, public relations and publicity, sales force and direct marketing- developing and managing an advertising program – setting objectives, deciding budget, choosing message – an overview on measuring effectiveness of a media – sales promotion – purpose, major decisions.

Text Book

1. Kotler P – Marketing Management 11th Edition – Pearson Eductation (Singapore) Pvt Ltd, New Delhi (2004)

References

1. Ramaswamy V S & Namkumari S – Marketing Management – Mc Millan India Ltd New Delhi (1997).
2. Saxena – Marketing Management 2nd Edition – Tata Mc Graw Hill (2002).

Sessional work assessment

Two tests = 30

Two assignments = 20

Total marks = 50

University examination pattern

Q I - 8 short type questions of 5 marks each, 2 from each module

Q II - 2 questions A and B of 15marks each from module I with choice to answer any one

Q III - 2 questions A and B of 15marks each from module II with choice to answer any one

Q IV - 2 questions A and B of 15marks each from module III with choice to answer any one

Q V - 2 questions A and B of 15marks each from module IV with choice to answer any one

ME04 805C Manufacturing Process of Non-Metals

3 hours lecture & 1 hour tutorial per week

Module I

Ceramics - structure and properties (13 hours)

Introduction: definition - classification - crystal structures - AX, AmXp & AmBnXp type crystal structures - crystal structures from close packing - density computations - silicate ceramics - silica - silica glasses - simple silicates - layered silicates - carbon: diamond - graphite - fullerenes - crystal imperfections: point defects - impurities - phase diagrams: alumina-chromia - alumina-silica systems - mechanical properties: hardness - brittle fracture - flexural strength - influence of porosity - mechanisms of plastic deformation

Module II

Ceramics - applications and processing (12 hours)

Glass: properties - forming - heat treatment - glass ceramics - clay: characteristics - compositions - fabrication techniques - hydroplastic forming - slip casting - firing - refractories: fire-clay - silica - basic and special

refractories - powder pressing - tape casting - advanced applications: heat engine - ceramic armor - electronic packaging

Module III

Polymers - structure and properties (14 hours)

Introduction - hydrocarbon molecules polymer molecules - chemistry - molecular weight - molecular shape - molecular structure - linear - branched - cross-linked and network polymers - molecular configurations - stereo isomerism - copolymers - polymer crystallinity - polymer crystals - thermo-mechanical characteristics - stress-strain behavior - deformation of semicrystalline polymers - mechanism - microscopic deformation - crystallisation - melting - glass transition - thermoplastic and thermosetting polymers - visco-elasticity - visco-elastic relaxation modulus - creep - deformation of elastomers - fracture of polymers - impact strength - fatigue - tear strength and hardness

Module IV

Polymers - applications and processing (13 hours)

Polymerization - addition - condensation - polymer additives - fillers - plasticisers - stabilisers - colorants - flame retardants - plastics - types, characteristics and applications - forming techniques - compression molding - transfer molding - injection molding - extrusion - blow molding - casting - elastomers - vulcanization - types, characteristics and applications - fibres - characteristics and applications - forming techniques - spinning - drawing - polymeric coatings - adhesives - films & foams - ultra-high molecular weight polyethylene - liquid crystal polymers - thermoplastic elastomers

Text book

Callister Jr., William D., "Materials Science and Engineering - An Introduction", John Wiley & Sons

Reference books

Schey & John A, "Introduction to Manufacturing Processes", McGraw Hill Intl.

Lindberg & Roy A, "Processes and Materials of Manufacture", Prentice Hall of India Pvt Ltd.

DeGarmo E Paul, Black JT, Kohser & Ronald A., "Materials and Processes in Manufacturing", Prentice Hall of India Pvt Ltd.

Budinski & Kenneth G., "Engineering Materials-Properties and Selection", Prentice Hall of India Pvt. Ltd.

Sessional work assessment

Two tests = 30

Two assignments = 20

Total marks = 50

University examination pattern

Q I - 8 short type questions of 5 marks each, 2 from each module

Q II - 2 questions A and B of 15marks each from module I with choice to answer any one

Q III - 2 questions A and B of 15marks each from module II with choice to answer any one

Q IV - 2 questions A and B of 15marks each from module III with choice to answer any one

Q V - 2 questions A and B of 15marks each from module IV with choice to answer any one

ME04 805D : Computational Fluid Mechanics

3 hours lecture and 1 hour tutorial per week

Module I (12 hours)

Classification of partial differential equations - system of first and second-order partial differential equations - initial and boundary conditions - finite difference formulations - finite difference equations - finite difference approximation of mixed partial derivatives

Module II (12 hours)

Parabolic partial differential equations - explicit methods - implicit methods - parabolic equations in two-space dimensions - consistency, stability, and error analysis of finite difference equations - artificial viscosity

Module III (12 hours)

Elliptic equations - finite difference formulations - solution algorithms - hyperbolic equations - finite difference formulations -splitting methods - multiple-step method

Module IV (16 hours)

Scalar representation of the navier - stokes equations - model equations - numerical algorithms - incompressible navier - stokes equations - primitive variable and vorticity - stream function formulations - poisson equation for pressure - numerical algorithms - boundary conditions - staggered grid

Text book

Hoffmann Klaus A., "Computational Fluid Dynamics for Engineers - Volume I", Engineering Education System, Wichita

Reference books

Patankar Suhas V., "Numerical Heat Transfer and Fluid Flow", Taylor & Francis

Fletcher C.A.J., "Computational Techniques for Fluid Dynamics I, Springer Verlag

Anderson Dale A., Tannehill John C. & Pletcher Richard H., "Computational Fluid Mechanics and Heat Transfer", Taylor & Francis

Sessional work assessment

Computer run assignments = 20

Two tests = 30

Total = 50

University examination pattern

Q I - 8 short type questions of 5 marks each, 2 from each module

Q II - 2 questions A and B of 15marks each from module I with choice to answer any one

Q III - 2 questions A and B of 15marks each from module II with choice to answer any one

Q IV - 2 questions A and B of 15marks each from module III with choice to answer any one

Q V - 2 questions A and B of 15marks each from module IV with choice to answer any one

ME04 805E : AUTOMOBILE ENGINEERING
3 hours lecture and 1 hour tutorial per week

Module I (hours)

Constructional Details : Introduction, classification of vehicle – Automobile component details – engine parts – cylinder- head – cylinder block, piston – different types of piston rings, connecting rod – crank shaft, crank shaft bearings, valve actuating mechanism.

Module II (hours)

Fuel systems: Fuel pump, fuel filter – Types of carburetor – simple carburetor – modern carburetors, petrol injection – MPFI, DI, CRDI – fuel pump and injectors for diesel engines.

Ignition system : Classification, battery ignition, electronic ignition – ignition coil, distributor, spark plug, starter mechanism – solenoid switch – over running clutch.

Cooling system: Radiator, methods of cooling coolant types.

Lubrication systems: Pressurized systems, grading of lubricating oil (SAE specification), oil filler, oil pump.

Module III (hours)

Transmission: Clutch- single and multi plate clutches, centrifugal clutch, fixed couplings

Gear box: Synchromesh gear box, propeller shaft, differential, Axles, semi floating, ¾ floating, full floating, front wheel drives, four wheel drives, over drives.

Brakes: Mechanical, hydraulic, vacuum and air brakes, independent and diagonal system. Steering mechanism – geometry, steering gears, worm and wheel, rack and pinion, screw and nut recirculating ball, power assisted steering, steering geometry – caster, camber, toe-in, toe-out, king pin inclination.

Module IV (hours)

Suspension: Independent suspension, strut, coil springs, shock absorber, torsion bar, independent rear suspension – isolated trailing link (ITL), air suspension systems.

Types of Wheels : Integrated rim, flat base rim alloy wheel, tyres – aspect ratio, crossply, radial tyres, wheel balancing.

Basic electric circuits : Battery charging, charging circuit, regulator.

Engine troubles: Detection and rectification, maintenance, preventive, periodic.
Air pollution control: Pollution norms – standards and legislation – Euro 3, emission control equipments and methods like, catalytic converter, canister, positive crank case ventilation (PCV), exhaust gas recirculation (EGR).

Safety systems: Side impact bar, crumble zones, air bags, collasple steering column.

References

1. Joseph Heitner – Automotive Vehicles
2. Kirpal Singh- Automobile Engineering Vol. I&II..

Sessional work assessment

Computer run assignments	= 20
Two tests	= 30
Total	= 50

University examination pattern

Q I - 8 short type questions of 5 marks each, 2 from each module

Q II - 2 questions A and B of 15marks each from module I with choice to answer any one

Q III - 2 questions A and B of 15marks each from module II with choice to answer any one

Q IV - 2 questions A and B of 15marks each from module III with choice to answer any one

Q V - 2 questions A and B of 15marks each from module IV with choice to answer any one

ME04 805F : Design Of Jigs & Fixtures

3 hours lecture and 1 hour tutorial per week

Module I (13 hours)

Introduction to jigs and fixtures – purpose of work holders – principles of jigs and fixture design – construction methods- materials used – process planning – typical operation layouts – operator analysis – cost analysis – machine analysis – examples of pre-design analysis – principles of locating and positioning – 3-2-1 principle – method of location – plane cylindrical – button – relieves – pin- spherical – radial - ν - redundant – nest locators – extreme locations.

Module II (13 hours)

Design and methods of clamping device – principles of clamping – standard fixture components – types of clamps – screw – strap – swing – hinge – pinch – wedge – multiple (2 way) – magnetic – latch – self locking – pneumatic – hydraulic – SAFE clamps – design considerations in work holder design and selection – machine vices – mandrals – collets – chucks – worked examples.

Module III (13 hours)

Fixtures – milling fixtures – slot and keyway milling fixture – fixture for milling flanges – straddle milling fixture – indexing fixture – face milling fixture with equalizers – profile milling fixture – examples of design and drawing of milling fixture for machining simple components – welding fixture – turning fixture.

Module IV (13 hours)

Drill jig – definition – drill guide bushings – jig feet and legs – types of drill jigs – template – vice – sandwitch - leaf – box – pump jigs - indexing jigs – indexing table – examples of design and drawing of drill jig for machining of simple components.

Reference books

1. MHA Kempster , An Introduction to Jigs and Tool Design, ELBS.
2. ASTMC, Fundamentals of Tool Design.
3. Grant H E, Jigs and fixture Non-standard clamping device, Tata McGraw Hill
4. Goroshkin A L , Jigs and Fixture, MIR Publishers
5. Donald son, Tool Design, Tata McGraw Hill
6. Colvin & Haas, Jigs and Fixture, McGraw Hill
7. E G Hoffman, Jigs and Fixture Design, Delmer Publishers.

Sessional work assessment

2 tests	2x15 = 30
2 Design and drawing assignments	
(one for Jig design and other for fixture design)	2x10 = 20
Total marks	= 50

University examination pattern

Q I - 8 short type questions of 5 marks each, 2 from each module

Q II - 2 questions A and B of 15marks each from module I with choice to answer any one

Q III - 2 questions A and B of 15marks each from module II with choice to answer any one

Q IV - 2 questions A and B of 15marks each from module III with choice to answer any one

Q V - 2 questions A and B of 15marks each from module IV with choice to answer any one

ME04 806(P) : CAD/CAM LABORATORY

3 hours practical per week

Objectives: At the end of this laboratory course you must be able to

Create and Edit solid models and working drawings

Perform Static and Dynamic analysis using FEM

Program and Simulate CNC machine tool operations

Program an industrial robot for simple material handling tasks

Demonstrate the capabilities of a CMM for quality control

1. Exercises on solid modeling (12 hours)

Introduction to computer graphics - viewing transformations, curves and surfaces generation, curve fitting and curve fairing techniques - 2D, wire frame, 3D shading - familiarity with Boolean operations - sweep, revolve, loft, extrude, filleting, chamfer, splines etc. - windowing, view point, clipping, scaling and rotation transformations using commercial solid modeling packages

2. Exercises on finite element analysis (12 hours)

Introduction to FEM - 1D, 2D and 3D elements - shape functions - preprocessing - boundary conditions, structured and free mesh generation - analysis - linear and non linear analysis - static and dynamic analysis - post processing - display, animation, extraction of nodal data - exercises on heat conduction and elasticity may be given using commercial FEM packages

3. Assembly and mechanism design (6 hours)

Assembling of various parts and tolerance analysis - synthesis and design of mechanisms - animations - exercises on various mechanisms like four bar linkages and its variations - cam and follower - two and four stroke engines

4. Computer aided manufacturing (9 hours)

Part programming fundamentals - manual part programming and computer aided part programming - hands on training in computer controlled turning and milling operations - familiarity with windows based software packages - tool path generation and simulation - exercises on CNC lathe and machining center/milling machines

5. Programming of industrial robots (6 hours)

Introduction to robotics - structure, workspace analysis and various components - actuators - sensors - encoders - end effectors - applications - hands on training on industrial robots - manual and programmed path planning

6. Computer aided inspection and quality control (3 hours)

Introduction to CMM - classification - structure - components - familiarity with measurement software packages and its modules - demonstration of the capability of coordinate measuring machine using a sample component e.g. - engine block - concepts of reverse engineering and rapid prototyping technology

Reference books

Rogers D.F. & Adams J.A., "Mathematical Elements for Computer Graphics", McGraw Hill

Rogers David F., "Procedural Elements for Computer Graphics", McGraw Hill

Cook, Robert Davis et al., "Concepts and Applications of Finite Element Analysis", John Wiley

Koren Yoram, "Computer Control of Manufacturing Systems", McGraw Hill

Kundra Rao & Tewari, "Numerical Control and Computer Aided Manufacturing", Tata McGraw Hill

Ramamurthy V., "Computer Aided Mechanical Design", Tata McGraw Hill

Fu K.S., Gonzalez R.C. & Lee C.S.G., "Robotics: Control, Sensing, Vision and Intelligence", McGraw Hill

Koren Yoram, "Robotics for Engineers", McGraw Hill

Bosch J.A., "Coordinate Measuring Machines and Systems", Marcel Decker Inc.

Sessional work assessment

Two tests	= 30
Two assignments	= 20
Total marks	= 50

ME04 807(P) : PROJECT

7 hours per week

The project work started in the seventh semester will continue in this semester - the students should complete the project work in this semester and present it before the assessment committee

The assessment committee as constituted in the seventh semester, will assess the various projects, fix the relative grading and group average marks - the guides will award the marks for the individual students in a project maintaining the group average - each group will submit the copies of the completed project report

signed by the guide (in the format prescribed by the department) to the department - the head of the department will certify the copies and return them to the students - one copy will be kept in the departmental library

Sessional work assessment

Presentation	= 60
Report	= 40
Total marks	= 100

ME04 808(P) : VIVA VOCE

There is only university examination for this - the university will appoint examiners for conducting the viva voce examination - the examiners will ask questions from subjects studied for the B.Tech. course, mini project, project and seminar reports of the student The relative weightage of questions shall be as follows.

Subjects	: 30
Mini project	: 20
Project	: 30
Seminar	: 20
Total marks	: 100