MECHANICAL ENGINEEING

3RD SEMESTER

Course Code	Course No.	Subject	Teaching Periods			Duration of Uty. Exam. (Hrs.)	Marks			
			Lect.	Tut.	Prac.		Sessional	Theory	Practical	Total
A	CMEL PA 301	Engineering Mathematics - II	3	1	-	3	50	100	-	150
B	M 302	Machine Drawing - I	-	-	4	3	50	100	-	150
C	M 303	Fluid Mechanics	2	2	-	3	50	100	-	150
D	M 304	Metallurgy & Material Science	3	1	-	3	50	100	-	150
E	M 305	Thermodynamics	2	2	-	3	50	100	-	150
F	M 306	Strength of Materials and Structural Engg.	3	1	-	3	50	100	-	150
G	M 307	Fluid Mechanics Laboratory	-	-	3	3	50	-	100	150
H	M 308	Strength of Materials Laboratory	-	-	3	3	50	-	100	150
		Total	13	7	10	-	400	600	200	1200

4TH SEMESTER

Course Code	Course No.	Subject	Teaching Periods			Duration of Uty. Exam. (Hrs.)	Marks			
			Lect.	Tut.	Prac.		Sessional	Theory	Practical	Total
A	CMEL RPTA 401	Engineering Mathematics - III	3	1	-	3	50	100	-	150
B	M 402	Theory of Machines-1	2	1	-	3	50	100	-	150
C	M 403	Hydraulic Machines	2	2	-	3	50	100	-	150
D	M 404	Machine Tools	2	1	-	3	50	100	-	150
E	M 405	Electrical Technology	3	1	-	3	50	100	-	150
F	M 406	Machine Drawing - II	-	-	4	4	50	100	-	150
G	M 407	Hydraulic Machines Laboratory	-	-	4	3	50	-	100	150
H	M 408	Electrical and Electronics Laboratory	-	-	4	3	50	-	100	150
		Total	12	6	12	-	400	600	200	1200

5TH SEMESTER

Course Code	Course No.	Subject	Teaching Periods			Duration of Uty. Exam. (Hrs.)	Marks			
			Lect.	Tut.	Prac.		Sessional	Theory	Practical	Total
A	CMEL PA 501	Engineering Mathematics - IV	3	1	-	3	50	100	-	150
B	M 502	Manufacturing Processes	3	1	-	3	50	100	-	150
C	M 503	Computer Programming	2	2	-	3	50	100	-	150
D	M 504	Theory of Machines II	2	2	-	3	50	100	-	150
E	M 505	Mechatronics and Control systems	2	2	-	3	50	100	-	150
F	M 506	Thermal Engineering - I	2	2	-	3	50	100	-	150
G	M 507	Computer Laboratory	-	-	3	3	50	-	100	150
H	M 508	Machine Tool Laboratory	-	-	3	3	50	-	100	150
		Total	14	10	6	-	400	600	200	1200

6TH SEMESTER

Course Code	Course No.	Subject	Teaching Periods			Duration of Uty. Exam. (Hrs.)	Marks			
			Lect.	Tut.	Prac.		Sessional	Theory	Practical	Total
A	M 601	Mechanics of Materials	2	2	-	3	50	100	-	150
B	M 602	Metrology and Instrumentation	3	1	-	3	50	100	-	150
C	M 603	Thermal Engineering - II	2	2	-	3	50	100	-	150
D	M 604	Heat and Mass Transfer	2	2	-	3	50	100	-	150
E	M 605	Principles of Management and Engineering Economics	3	1	-	3	50	100	-	150
F	M 606	Computer Aided Design and Manufacturing	3	1	-	3	50	100	-	150
G	M 607	Heat Engines Laboratory	-	-	3	3	50	-	100	150
H	M 608	Advanced Machine Tool Laboratory	-	-	3	3	50	-	100	150
		Total	15	9	6	-	400	600	200	1200

7TH SEMESTER

Course Code	Course No.	Subject	Teaching Periods			Duration of Uty. Exam. (Hrs.)	Marks			
			Lect.	Tut.	Prac./ Proj.		Sessional	Theory	Practical	Total
A	M 701	Gas Dynamics and Jet Propulsion	2	1	-	3	50	100	-	150
B	M 702	Industrial Engineering	2	1	-	3	50	100	-	150
C	M 703	Refrigeration and Air Conditioning	2	1	-	3	50	100	-	150
D	M 704	Dynamics of Machinery	2	1	-	3	50	100	-	150
E	M 705	Machine Design and Drawing - I	2	-	2	3	50	100	-	150
F	M 706	Elective - I	3	1	-	3	50	100	-	150
G	M 707	Mechanical Engineering Laboratory	-	-	4	3	50	-	100	150
H	M 708	Heat Transfer Laboratory	-	-	4	3	50	-	100	150
I	M 709	Project and Seminar	-	-	2	-	-	-	-	-
		Total	13	5	12	-	400	600	200	1200

8TH SEMESTER

Course Code	Course No.	Subject	Teaching Periods			Duration of Uty. Exam. (Hrs.)	Marks			
			Lect.	Tut.	Prac./ Proj.		Sessional	Theory	Practical	Total
A	M 801	Production Engineering	2	1	-	3	50	100	-	150
B	M 802	Automobile Engineering	3	1	-	3	50	100	-	150
C	M 803	Production Planning and Control	2	1	-	3	50	100	-	150
D	M 804	Machine Design and Drawing - II	2	-	2	3	50	100	-	150
E	M 805	Elective - II	3	1	-	3	50	100	-	150
F	M 806	Elective - III	3	1	-	3	50	100	-	150
G	M 807	Mechanical Measurements Laboratory	-	-	4	3	50	-	100	150
H	M 808	Project and Seminar	-	-	4	-	100	-	-	100
I	M 809	Viva Voce	-	-	-	-	-	-	50	50
		Total	15	5	10	-	450	600	150	1200

THIRD SEMESTER

ENGINEERING MATHEMATICS - II

CMELPA 301 **3+1+0**

Module 1 Vector Differential Calculus

Differentiation of vector functions - scalar and vector fields – gradient, divergence and curl of a vector function – their physical meaning – directional derivative – scalar potential, conservative fields – identities – simple problems.

Module 2 Vector Integral Calculus

Line, surface and volume Integrals – work done by a force along a path – Application of Green's theorem, Stokes theorem and Gauss divergence theorem.

Module 3 Function of Complex Variable

Definition of analytic functions and singular points – derivation of C.R. equations in Cartesian co-ordinates – harmonic and orthogonal properties – construction of analytic function given real or imaginary parts – complex potential – conformal transformation of function like z^n, e^z, $1/z$, $\sin z$, $z+k^2/z$ – bilinear transformation – cross ratio – invariant property – simple problems.

Module 4 Finite Differences

Meaning of Δ, ∇, E, μ, δ - interpolation using Newton's forward and backward formula – central differences – problems using stirlings formula – Lagrange's formula and Newton's divided difference formula for unequal intervals.

Module 5 Difference Calculus

Numerical differentiation using forward and backward differences – Numerical integration – Newton – Cote's formula – trapezoidal rule – Simpson's $1/3^{rd}$ and $3/8^{th}$ rule – simple problems. Difference equations – Solution of difference equations.

References

1. Advanced Engg. Mathematics - Erwin Kreyszig, Wiley Eastern Ltd.
2. Higher Engg. Mathematics - Grawal B.S., Khanna Publishers
3. Numerical Methods in science & Engg. -M.K.Venkataraman, National Publishing Co
4. Numerical Methods - S.Balachandra Rao and G.K.Shantha, Uty. press
5. Advanced Engg. Mathematics - Michael D.Greenberg, Prentice-Hall

6. Theory and Problems of Vector analysis - M.R.Spiegel, Schaum's outline series, McGraw – Hill

MACHINE DRAWING - I

M 302 **0+0+4**

Conversion of pictorial views into orthographic views-dimensioning techniques-preparation of drawing- screw threads-different forms-conventional representation-sketching-orthographic views of hexagonal bolts and nuts-dimensional drawing-squareheaded bolts and nuts-sketching of different types of lock nuts and locking devices and foundation bolts.

Forms of rivet heads-rivetted joints-lap and butt joints with single and multiple riveting in chain and zig-zag arrangements-dimensional drawing. Sketching of conventional representation of welded joints.

Fully dimensioned and sectional drawings of the following: -
Joints-cottered joints (spigot and socket, sleeve and cotter, gib and cotter) - knuckle joint. Shaft couplings - types of keys - plain and protected types of flanged couplings - bushed pin type flexible coupling - Oldhams coupling.

Pipe joints-spigot &socket joint - flanged joint - union joint –Amstrong (hydraulic) joint.
Shaft bearings and supports - journal bearing, plummer block - footstep bearing-wall bracket - ball bearings.

Steam engine parts - stuffing box - cross head - connecting rod - eccentric.

I.C.Engine parts-piston, connecting rod.

References

1. Machine Drawing - N.D.Bhatt
2. Machine Drawing - P.I.Varghese
3. Machine Drawing - P.S.Gill

FLUID MECHANICS

M 303 **2+2+0**

Module 1

Introduction-Proprties of fluids- pressure, force, density, specific weight, compressibility, capillarity, surface tension, dynamic and kinematic viscosity-Pascal's law-Newtonian and non-Newtonian fluids-fluid statics-measurement of pressure-variation of pressure-manometry-hydrostatic pressure on plane and curved surfaces-centre of pressure-buoyancy-floation-stability of submerged and floating bodies-metacentric height-period of oscillation.

Module 2

Kinematics of fluid motion-Eulerian and Lagrangian approach-classification and representation of fluid flow- path line, stream line and streak line. Basic hydrodynamics-equation for acceleration-continuity equation-rotational and irrotational flow-velocity potential and stream function-circulation and vorticity-vortex flow-energy variation across stream lines-basic field flow such as uniform flow, spiral flow, source, sink, doublet, vortex pair, flow past a cylinder with a circulation, Magnus effect-Joukowski theorem-coefficient of lift.

Module 3

Euler's momentum equation-Bernoulli's equation and its limitations-momentum and energy correction factors-pressure variation across uniform conduit and uniform bend-pressure distribution in irrotational flow and in curved boundaries-flow through orifices and mouthpieces, notches and weirs-time of emptying a tank-application of Bernoulli's theorem-orifice meter, ventury meter, pitot tube, rotameter.

Module 4

Navier-Stoke's equation-body force-Hagen-Poiseullie equation-boundary layer flow theory-velocity variation- methods of controlling-applications-diffuser-boundary layer separation –wakes, drag force, coefficient of drag, skin friction, pressure, profile and total drag-stream lined body, bluff body-drag force on a rectangular plate-drag coefficient for flow around a cylinder-lift and drag force on an aerofoil-applications of aerofoil- characteristics-work done-aerofoil flow recorder-polar diagram-simple problems.

Module 5

Flow of a real fluid-effect of viscosity on fluid flow-laminar and turbulent flow-boundary layer thickness-displacement, momentum and energy thickness-flow through pipes-laminar and turbulent flow in pipes-critical Reynolds number-Darcy-Weisback equation-hydraulic radius-Moody;s chart-pipes in series and parallel-siphon losses in pipes-power transmission through pipes-water hammer-equivalent pipe-open channel flow-Chezy's equation-most economical cross section-hydraulic jump.

References

1. Hydraulics and Fluid Mechanics - Lewitt
2. Fluid Mechanics - I.H.Shames
3. Fluid Mechanics - B.S.Massey
4. Fluid Mechanics - K.L.Kumar
5. Hydraulics and Fluid Mechanics - R.K.Bhansal
6. Hydraulics and Fluid Mechanics - Mody and Seth

METALLURGY AND MATERIAL SCIENCE

M 304 **3+1+0**

Module 1

Crystallography: Crystal structural determination, crystallographic directions and planes, miller indices, packing of atoms in solids, atomic packing factor, co-ordination number- A*morphous structure*, glass transition temperature -- Effects of crystalline and amorphous structure on mechanical and optical properties -- *Mechanism of crystallization:* Homogeneous and heterogeneous nuclei formation, dendritic growth and grain boundary irregularity, grain size effects on mechanical & optical properties - *Changes within solid materials*: *Structural imperfections:* Point defects - line defect: edge, screw dislocation, burgers vector, forest of dislocations, role of dislocation in the deformation of metals - Surface imperfections: role of surface defect on crack propagation etc – *Mode of* p*lastic deformation*: mechanism of slip & twinning, dislocation climb & cross slip, dislocation sources, frank-read source – D*iffusion* in solids, fick's laws, applications.

Module 2

Cold working, strain hardening, recovery, re-crystallization, grain growth, grain size and its effects on mechanical properties-- Hot working, super plasticity – Reasons for alloying, phase transformation phase rules, single phase, multi phase equilibrium diagrams, solid solutions, inter metallic compounds – Equilibrium diagram reactions: monotectic, eutectic, eutectoid, peritectic, peritectoid -- Polymorphism – Detailed discussion of Iron-Carbon diagram with microstructure changes in ferrite, austenite, cementite, graphite, pearlite, martensite, bainite.

Module 3

Definition and aims of *heat treatment*- Annealing, spheroidizing, normalizing, hardening, tempering, austempering, martempering with microstructure changes -- *Surface treatment*: Diffusion methods: carburizing, nitriding, cyaniding -- Thermal methods: flame hardening, induction hardening – Deposition methods: hot dipping and coating, impregnation, metal spraying, metal cladding – *Various strengthen mechanisms in metals:* work hardening, grain boundary hardening, grain size reduction, solid solution hardening, dispersion hardening.

Module 4

Alloy steels: Effects of alloying elements on: dislocation movement, polymorphic transformation temperature, formation and stability of carbides, grain growth, displacement of the eutectoid point, retardation of the transformation rates, improvement in corrosion resistance, mechanical properties -- Nickel steels, chromium steels, etc – Effects on steels, containing molybdenum, vanadium, tungsten, cobalt, silicon, copper and lead – high speed steels - - *Cast irons:* classifications, gray, white, malleable and spheroidal graphite cast iron, composition, microstructure, properties and applications - *Principal non ferrous alloys* like aluminum, beryllium, copper, magnesium, nickel, study of composition, microstructure, properties and applications- Reference shall be made to the phase diagrams whenever necessary.

Module 5

Fracture: Bonding forces and energies, cohesive strength of metals - Griffith theory –- Crack initiation, growth and crack arrest – Effect of plastic deformation on crack propagation – Factors leading to crack propagation - Cleavage, intercrystalline, brittle, ductile fracture -- Influence of slip on fracture – Effect of impact loading on ductile material and its application in forging etc.-- *Fatigue:* stress cycles – Effects of stress concentration, size effect, surface texture on fatigue – Corrosion and thermal fatigue – Mechanism of fatigue failure -- *Creep:* Creep curves – Structural change – Mechanism of creep deformation.

References

1. Avner S.H. – Introduction to Physical Metallurgy – McGraw Hill.
2. Callister William. D. – Material Science and Engineering. – John Wiley.
3. Guy A.G. – Essentials of material science. – McGraw Hill.
4. Dieter George E. – Mechanical Metallurgy. – McGraw Hill.
5. Higgins R.A. – Engineering Metallurgy part-I. – ELBS.
6. Mans Chandra – Science of Engineering Materials Vol. 1, 2, 3. – Macmillan.
7. Reed Hill E. Robert – Physical Metallurgy Principles. – East West Press.
8. Richards C.W. – Engineering Material Science.
9. Van Vlack – Elements of material Science. Addison – Wesley.
10. www. msm. com. ac. uk / online teaching.

THERMO DYNAMICS

M 305 **2+2+0**

Module 1

Fundamental concepts-Scope and limitations of thermo dynamics- Thermo dynamic systems – different types of systems-macroscopic and microscopic

analysis-continuum-Properties-State-Processes- -Thermo dynamic equilibrium-Equation of state of an ideal gas-PVT system-Real gas-Real gas relations-Compressibility factor-Law of corresponding states.

Module 2

Laws of thermo dynamics-Zeroth law of thermo dynamics-Thermal equilibrium-Concept of temperature –Temperature scales-Thermometry-Perfect gas temperature scales. Work and Heat-First law of thermo dynamics-concept of energy-first law for closed and open systems-specific heats- internal energy and enthalpy- Steady flow energy equation- Joule Thompson effect.

Module 3

Second law of thermo dynamics-Various statements and their equivalence-Reversible process and reversible cycles – Carnot cycle-Corollaries of the second law-Thermo dynamic temperature scale- Clausius inequality-Concept of entropy-Calculation of change in entropy in various thermo dynamic processes-Reversibility and irreversibility-Available and unavailable energy – Third law of thermo dynamics.

Module 4

Thermo dynamics relations-Combind first and second law equations-Helmholtz and Gibbs functions – Maxwell relations- equations for specific heats, internal energy, enthalpy and entropy – Clausius- Clapeyron equation – applications of thermo dynamic relations.

Module 5

Properties of pure substances – PVT, PT and TS diagrams,Mollier diagrams-Mixture of gases and vapours-mixture of ideal gases-Dalton's law-Gibbs law – Thermo dynamic properties of mixture-mixtures of ideal gases and vapours-Psychrometic principles-Psychrometic chart-Applications.

References

1. Engineering Thermodynamics - P.K.Nag
2. Thermodynamics - J.F.Lee and F.W.Sears.
3. Engineering Thermodynamics - Spalding and Cole
4. Engineering Thermodynamics - M.Achuthan
5. Thermodynamics - Keenan
6. Thermodynamics - Obert
7. Thermodynamics - Holman
8. Heat and Thermodynamics - M.N.Zemansky
9. Thermodynamics - Rogers, Pearson

STRENGTH OF MATERIALS AND STRUCTURAL ENGINEERING

M306 **3+1+0**

Module 1

I Stress and strain - Bars of varying cross - sections – composite sections - temperature stresses. Principal stresses and planes-Mohr's circle representation of plane stress.

Module 2

Shear force and bending moments -Cantilever-simply supported and overhanging beams-concentrated and U. D. loadings analytical method. Relation between load. SF and BM. Theory of simple bending- bending and shear stress distribution rectangular, circular and 1-sections.

Module 3

Slope and deflection of simply supported beams and cantilevers- Double integration- Macaulay's Method-moment area method- conjugate beam method.

Module 4

Torsion of circular shafts-solid and hollow shafts- power transmitted by shafts. Close-coiled and open coiled spring- leaf spring. Thin cyliders and jhick cylinders subjected to internal and external pressures- compound pipes -wire wound pipes-strain energy-axial loads, gradually and suddenly applied load-impact loads.

Module 5

Columns and sturts- short and long columns-Euler's theory-Ran kine's theory - Eccentrically Loaded columns-column with initial curvature. General description only of simple and compound steel, beams, columns and column foundation-principle of reinforced concrete. Reinforcements detailing in R. C. Slabs, beams, columns & footings (No problem expected)

References

1. Timoshenko.S.P, Strength of Materials, Part 1,D.Van Nostrand company, Inc.Newyork.
2. Popov E.P., Engineering Mechanics of solids, Prentice Hall of India, New Delhi.
3. Punmia B.C, Strength of Materials and Mechanics of structures, Vol 1,Lakshmi Publications, New Delhi.
4. Vazirani V.N., Ratwani N. M, Analysis of Structures, Vol 1, Khanna Publishers, New Delhi.
5. Kazimi S.M.A., Solid Mechanics, Tata Mc Graw Hill.
6. William A Nash, Strength of Materials, Mc Graw Hill.
7. Ryder G.H., Strength of Materials, ELBS.
8. Arthur Morley, Strength of Materials, ELBS, Longman’s Green& Company.

FLUID MECHANICS LABORATORY

M 307 **0+0+3**

1. Study of plumbing tools and pipe fittings
2. Study of taps, valves, gauges, pitot tubes, watermeters and current meters
3. Determination of metacentric height and radius of gyration of floating bodies.
4. Hydraulic coefficients of orifices and mouthpieces under constant head method and time of emptying method.
5. Calibration of venturimeter, orifice meter and water meter
6. Calibration of rectangular and triangular notches
7. Determination of Darcy's and Chezy's constant for pipe flow
8. Determination of critical velocity in pipe flow.
9. Determination of minor losses in pipe flow
10. Experimental verification of Bernoulli's theorem
11. Determination of Chezy's constant and Mannings number for open channel flow.
12. Determination of discharge coefficient for Plug-Sluices

STRENGTH OF MATERIALS LABORTAORY

M308 **0+0+3**

1. Tests on springs (open and close coiled)
2. Bending Test on Wooden Beams using U. T. M. '
3. Verification of Clerk. Maxwell's Law of reciprocal deflection and determination of E for steel.
4. Torsion Pendulum (M.S. wires. Aluminum wires and brass wires)
5. Torsion test using U. T. M. on M. S. Rod, torsteel and High Tensile steel.
6. Torsion Test on M. S, Road
7. Shear Test on M.S. Rod.
8. Fatigue Test
9. Impact Test (Izod and Charpy)
10. Hardness Test (Brinell, Vicker's and Rebound)
11. Strut Test.

Note

All tests should be done as per relevant BIS

FOURTH SEMESTER

ENGINEERING MATHEMATICS - III

CMELRPTA 401 **3+1+0**

Module 1

Ordinary Differential Equations: Linear Differential equations with constant coefficents - Finding P.I. by the method of variation of parameters – Cauchys equations- Linear Simultaneous eqns- simple applications in engineering problems.

Module 2

Partial Differential Equations: Formation by eliminating arbitrary constants and arbitary Functions - solution of Lagrange Linear Equations –Charpits Method – solution of homogeneous linear partial differential equation with constant coefficients – solution of one dimensional wave equation and heat equation using method of separation of variables – Fourier solution of one dimensional wave equation.

Module 3

Fourier Transforms: Statement of Fourier Integral Theorems – Fourier Transforms – Fourier Sine & Cosine transforms - inverse transforms - transforms of derivatives – Convolution Theorem (no proof) – Parsevals Identity - simple problems.

Module 4

Probability and statistics: Fundamentals of probability, Bayes theorem - Binomial law of probability - The binomial distribution, its mean and variance - poisson distribution as a limiting case of binomial distribution - its mean and variance - fitting of binomial & poisson distributions - normal distribution - properties of normal curve - standard normal curve - simple problems in binomial, poisson and normal distributions.

Module 5

Population & Samples: Sampling distribution of mean (σ known) –Sampling distribution of variance, F and Chi square test – Level of significance - Type 1 and Type 2 errors – Test of hypothesis – Test of significance for large samples – Test of significance for single proportion, difference of proportions, single mean and difference of means (proof of theorems not expected)

References

1. Higher Engineering Mathematics - B.S. Grewal, Khanna Publishers
2. Engineering Mathematics Vol. II -3rd year Part A & B - M.K. Venkataraman, National Publishing Company
3. Elements of Partial Differential Equations - Ian N.Sneddon, McGrawhill International Edn.
4. Miller and Fread's Probability and statistics for engineers – Richard A Johnson, Pearson Education Asia / PHI

5. A text book of Engineering Mathematics (Volume II) – Bali and Iyengar, Laxmi Publications Ltd.
6. Advanced Engg. Mathematics Erwin Kreyszig, Wiley Eastern Ltd.
7. Probability and statistical inferences – Hogg and Tanis, Pearson Education Asia

THEORY OF MACHINES - I

M 402 **2+1+0**

Module 1

Kinematics: Links, pairs, chain, mechanisms, machines, inversion of single and double slider crank, quadric cycle chains-kinematic diagram-expression for degree of freedom- equivalent curves- coupler curves-spatial mechanisms-manipulations- velocity analysis by instantaneous center method-Kennedy's theorem- velocity and acceleration of various mechanisms by analytical and graphical method-Coriolis component of acceleration-analytical treatment of slider crank and four bar chain-Klein's construction-locating instantaneous center-velocity and acceleration image.

Module 2

Linkage Synthesis: Precision points-graphical synthesis of slider crank mechanisms, rocker mechanisms, four bar linkage-overlay method-number synthesis-basic features of mechanical synthesis-graphic and analytical methods of dimensional synthesis-kinematic synthesis-approximate and exact synthesis.

Module 3

Mechanisms: Pantograph, approximate straight line, straightline mechanisms-engine indicator mechanisms-steering gear-Davis and Ackerman type-quick return- Whitworth, slider crank mechanism-Hooke's joint, Scott-Russel, Watt and grasshopper mechanisms.

Module 4

Brakes and clutches: Shoe, double block, long shoe, internally expanding shoe, band, band & block, hydraulic, mechanical, air and powerbrakes-braking of avehicle-cone, single plate, multiple, centrifugal clutches.

Dynamometers: Pony brake. rope brake, epicyclic train, belt transmission and torsion dynamometers-effort and power.

Module 5

Gears: Condition for constant velocity ratio-law of gearing-conjugate teeth action-tooth forms-standard modules and tooth proportions-contact ratio-interference-spur, helical, bevel, spiral, and hypoid gears- gear forces.

References

1. Theory of Machines - Thomas Bevan
2. Mechanisms and Machine Theory - Ambedkar
3. Theory of Mechanisms and Machines - A.Ghosh & A.K.Mallick

4. Theory of Machines - V.P.Singh, Pearson
5. Theory of Machines - P.L.Bellaney
6. Theory of Machines and Mechanisms - J.E.Shigley & J.J.Uicker

HYDRAULIC MACHINES

M 403 **2+2+0**

Module 1

Dynamic Action of Fluid: Momentum and angular momentum equation applied to control volume – impact of jet – flow of an incompressible fluid over fixed and moving vanes – workdone and efficiency – reaction principle – propulsion of ships. Dimensional analysis – Rayleigh' s method – Buckingham's Pi theorem – nondiamesional parameters in fluid mechanics and fluid machinery – principle of similitude, geometric and dynamic similarity – model studies.

Module 2

Euler`s turbine equation: velocity triangles – impulse and reaction turbines – Pelton wheel, Francis turbine Kaplan turbine – construction features and performance characteristics – non dimensional parameters for comparative study of turbine performance – unit speed, unit power, unit quantity, run away speed, geometric similarity – model laws – effect of specific speed on speed, runner size, flow type etc. – theory of draft tube – speed regulation of turbines – selection, type and speed of turbines.

Module 3

Pumping machinery: General classification –Dynamic pumps - working of centrifugal pumps, priming, vapour pressure, wear rings, hydraulic balancing, Classification of impellers, impeller shapes – types of casings – materials for pumps & medical use – principle of operation Euler`s head equation – velocity diagrams – losses in pumps – circulatory flow – pre rotation – efficiency – non dimensional parameters – specific speed – effect of change of diameters & speed - performance pump characteristics: main, operating, ISO efficiency characteristics curves – surging – NPSH – selection of pumps from performance curves, suction & delivery pipe sizing, motor rating - equivalent length of pipe, simple head loss calculation in pipe lines & fittings – Principle of similitude – axial trust – multistage pumps – propeller pumps – pump in parallel & series operation.

Module 4

Theory, efficiency, performance curves & application of self-priming pump, jet pump, airlift pump, slurry pump & hydraulic ram - Positive displacement pumps: reciprocating pump, effect of vapour pressure on lifting of liquid – indicator

diagram – acceleration head – effect of friction – use of air vessels – work saved – Slip - efficiency – pump characteristics – applications. Condition monitoring of pumps: temperature on bearing, vibration in equipmets, noises – vibration measurement and fault diagnosis. Cavitation in fluid machines – installations susceptible to cavitation – collapse of bubble theory – Thoma`s prameter – factors affecting cavitation in pumps and turbines – Abrasive wear of pumps - prevention of cavitation damage.

Module 5

Positive displacement Rotary pumps: Gear, screw, vane, root pumps – rotary axial & rotary radial piston pumps - theory, efficiency, performance curves, effect of surface texture & materials of construction on performance – applications. Hydraulic accumulator, intensifier & lift – principle of operation- Hydraulic symbols, hydraulic cranes, hydraulic capstan, hydraulic press.

References

1. Abdulla Sheriff - Hydraulic machines, standard publishers.
2. Govinda Rao N. S. - Fluid flows machines, TMH.
3. Jagadishlal. - Hydraulic machines, metropolitan publishers.
4. Pippinger. - Industrial hydraulics.
5. Centrifugal and axial flow pumps - Wiley & sons. – Stepanoff John A. J.
6. Lewitt E. H. - Hydraulic & Fluid Mechanics

MACHINE TOOLS

M 404 **2+1+0**

Module 1

Types and classification of lathes: Specifications-method of holding work and tool, accessories, attachments-operations and types of tools for each operation-tool room lathe- duplicating lathe-Capstan and Turret lathe-horizontal and vertical automatics-single spindle and multi-spindle screw machines-manufacture of cylindrical bolts, stepped bolts, shafts-profile turning. Drilling and boring machines:- types and specifications-description of tool and work holding devices-boring tools and reamers-drilling of holes, countersinking and counterboring operations-boring of cross holes-manufacture of bushes.

Module 2

Shaping, planing and slotting machines: Types and specifications-quick return motion-hydraulic feed and its advantages-automatic feed-speed, feed and depth of cut-work holding devices-types of operation and examples of work done-shaping of V-blocks, planing of guide gibs, slotting of keyways. Broaching machines:-types-cutter-processes-internal and external broaching-broaching of spline-bores. Milling machines: - types, specifications, operations and milling cutters-Indexing

head and its use-method of indexing-dividing head-milling of plane surface, keyways, slides and hexagons.

Module 3

Grinding, Horning and Lapping: Types and methods of operations-tool and cutter specifications-surface finish obtainable-method of evaluation of surface finish-roughness-super finishing-burnishing-ultrasonic impact grinding-grinding of shafts and bores-methods of gear cutting-form cutters-gear generating machines-gear hobbing -straight, spiral, worm, helical, and bevel gear cutting-gear finishing and gear shaping operations-gear errors.

Module 4

Numerical Control (NC) machine tools: Elements, classification (basics only)-NC tooling-design of NC/CNC tooling-automated chip less process.

Automatic machines: Semiautomatic multi tool central lathes-automatic cutting of machines- Swiss type automatic screw machines, multi spindle automatic special purpose machine tools- program controlled machine tools-copying machines.

Module 5

Computers in production technology: CIM-computer simulation of manufacturing process and systems-cellular manufacturing-FMS - just in time production-management of toolroom-machining centers-automatic tool changing-manufacture of ICs, PCBs, Ceramic circuit boards, and advanced PCBs-expert systems in manufacturing-unmanned machining- trends in automated factory.

References

1. Production Technology - R.K.Jain
2. All about Machine tools - Gerling
3. Workshop Technology: Vol. 1,2 and 3 - W.A.J.Chapman
4. Production Technology - H.M.T.
5. Machine Tools: Vol. 1, 2, 3 and 4 -Acherkan
6. Manufacturing Science & Technology, Vol. 2 -Suresh Daleela
7. Manufacturing Engineering &Technology -S.Kalpakjian, S.A.Schmidt

ELECTRICAL TECHNOLOGY

M 405 **3+1+0**

Module 1

Transformer - emf equation: No load current - equivalent circuit - regulation - efficiency. Determination of regulation and efficiency from O.C. and S.C. tests - cooling of transformers.

D.C. motors: Back emf - speed and torque equation - starting and speed control - testing of D.C. motors - brake test - swinburn's test.

Module 2

Alternators - construction details: Type - emf equation (winding factor need not be derived) - synchronous impedance - regulation by emf and mmf method. Synchronous **Motors:** Principle of operation - method of starting.

Three phase induction motor: Production of rotating magnetic field equivalent circuit-torque equation - torque slip characteristics - no load and blocked rotor tests - starting and speed control.

Single phase motor: Double revolving theory - capacitor start capacitor run induction motors – applications.

Module 3

Industrial drives - electric drives - advantages - individual drive and group drive - factors affecting choice of motor - mechanical characteristics of A.C. and D.C. motors - motors for particular applications like textile mill, steel mill, paper mill, mine, hoists, crane etc. - size and rating of motor – motor Selection for intermittent loads. Electric traction - Different systems of traction - comparison – track electrification - different systems - traction motor characteristics - electric braking - plugging -Dynamic and regenerative braking.

Module 4

Basic principle of transistor amplifier - R.C. coupled amplifier- F.B. amplifier - Basic principle. Oscillators - basic principle - typical R.C. and L.C. oscillator circuits (no analysis) –Astable multivibratior Pulse circuits - wave shaping circuits like simple clipping, clamping R.C. differentiating, integrating circuits - simple sweep generator. CRO - basic principle of cathode ray tube - deflection methods – block schematic of CRO - measurement of current, voltage and frequency.

Module 5

Power semiconductor devices: Power diodes - SCR's - Principle of operation of SCR's - two transistor analogy of SCR - characteristics - SCR rating (basic principle only). High frequency heating - induction and dielectric heating –

resistance heating Resistance welding - block schematic of resistance welding scheme

References

1. Perfomance and design of D C machines – Clayton
2. Perfomance and design of A C machines – M G Say
3. Electrical Traction – Dover A T
4. Industrial and Power electronics – Harish C Rai
5. Electronic principles S K Sahdev

MACHINE DRAWING - II

M 406 **0+0+4**

Assembly and working drawings of the following: -

1. Valves: - Feed checkvalve, stop valve, spring loaded safety valve, Ramsbottom safety valve, lever safety valve, deadweight safety valve, blow off cock.
2. Pulleys: - Fast and loose pulleys, speed cone or stepped pulley.
3. Clutches: - Single plate clutch, cone friction clutch.
4. Machine elements: - lathe spindle, screw jack, machine vice, lathe tool post.

References

1. Machine Drawing - N.D.Bhatt
2. Machine Drawing - P.I.Varghese
3. Machine Drawing - P.S.Gill

HYDRAULIC MACHINES LABORATORY

M 407 **0+0+4**

Study of hydraulic turbines – Pelton wheel, Francis & Kaplan turbines – force due to impact or jet on vanes – velocity triangles – specific speed – types of casings – governing – cavitation – draft tubes - performance characteristics – applications.

Study of dynamic pumps: Centrifugal pump - velocity triangles – priming - vapour pressure, wear rings, hydraulic balancing - casings – impellers – specific speed – cavitation - selection of pumps from performance curves, suction & delivery pipe sizing, motor rating, equivalent length of pipe, crane co. table, simple head loss calculation in pipe lines - applications. Theory, efficiency,

performance curves & application of self-priming pump, jet pump, airlift pumps slurry pump & hydraulic ram.

Condition monitoring of pumps: temperature on bearing, vibration in equipmets, noises – vibration measurement and fault diagnosis. Study of positive displacement pumps – Reciprocating pumps – single & multi cylinder – Air vessel – indicator diagram - - performance characteristics – applications. Positive displacement Rotary pumps: Gear, screw, vane, root pumps – rotary axial & rotary radial piston pumps - theory, efficiency, performance curves, effect of surface texture & materials of construction on performance - applications.

Experiments

Performance characteristic tests on Pelton wheel (Load test & best speed).
Performance characteristic tests on Francis turbine (Load test & best gate opening).
Performance characteristic tests on Kaplan turbine (Load test & best gate, vane angle opening).
Performance characteristic tests on single stage, multi stage centrifugal pumps at constant speed & at variable speed. Actual & predicted curves.
Performance characteristic tests on self-priming pump, Jet pump, Airlift pump and deep well pump
Performance characteristic tests on axial flow pump.
Performance characteristic tests on Hydraulic ram.
Vibration measurement and computer aided fault diagnosis of a centrifugal / self-priming / Gear / Reciprocating pump.
Performance characteristic tests on reciprocating pump at constant speed.
Performance characteristic tests on Gear pump.
Performance characteristic tests on Screw pump.

References

1. Abdulla Sheriff. - Hydraulic machines, standard publishers.
2. Govinda Rao. N. S - Fluid flows machines, TMH.
3. Jagadishlal - Hydraulic machines, metropolitan publishers.
4. Pippinger - Industrial hydraulics.
5. Stepanoff john A.J. -Centrifugal and axial flow pumps, Wiley & sons**.**

ELECTRICAL & ELECTRONICS LABORATORY

M408 **0+0+4**

ELECTRICAL MACHINES LAB

1. Efficiency and regulation of single phase transformer by direct loading.
2. Equivalent circuit of transformer from open and short circuit test-calculation of efficiency and regulation at various loads and power factors.
3. Regulation of alternator by emf and mmf methods.
4. Starting of cage induction motor using star-delta switch - performance characteristics.
5. No load and blocked rotor test on slip ring induction motor - equivalent circuit - torque-slip characteristics.
6. a) O.C.C. of D. C. shunt generator - critical resistance.-critical speed.
   b) External and internal characteristics of D C shunt generator.
7. Load test on D. C. series motor.
8. Swinbume's test -Pre determination of efficiency.
9. Study of single phase induction motor, determination of performance characteristics.

ELECTRONICS LAB

1. Diode characteristics
2. Transistor characteristics- C.B, C.E configurations
3. Pulse circuits
4. Rectifier circuits
5. Sweep generator
6. R C Coupled amplifier
7. R C Oscillator, L C Oscillator
8. Astable multivibrator

FIFTH SEMESTER

ENGINEERING MATHEMATICS - IV

CMELPA501 **3+1+0**

Module 1

Complex Integration: Line Integral –Cauchy's integral theorem- Cauchy's integral formula-Taylor's series-Laurent's series- zeros and singularities-Residues- residue theorem-Evaluation of real integrals using contour integration involving unit circle and semicircle.

Module 2

Numerical solution of algebraic and transcendental equations: Successive bisection method-Regula falsi method - Newton –Raphson method – solution of system of linear equations by Jacobi's iteration method and Gauss-Siedel method.

Module 3

Numerical solution of ordinary differential equation: Taylor's series method-Euler's method –Modified Euler's method - Runge – Kutta method (IV order)-Milne's predictor corrector method.

Module 4

Z – Transforms: Definition of Z transform- properties –Z transform of polynomial functions – trigonometric functions, shifting property, convolution property-inverse transform – solution of 1^{st} & 2^{nd} order difference equations with constant coefficients using Z transforms.

Module 5

Linear programming: graphical solution – solution using simplex method (non – degenerate case only) – Big-M method, two phase method- Duality in L.P.P.-Balanced T.P. – Vogels approximation method – Modi method.

References

1. Advanced Engineering Mathematics – Ervin Kreyszig, Wiley Eastern limited.
2. Numerical methods in Engineering & Science – Dr. B.S.Grewal, Kanna Publishers.
3. Higher Engineering Mathematics – Dr. B.S.Grewal, Kanna Publishers.
4. Numerical methods in Science & Engineering – Dr. M.K.Venkitaraman, National Publishing Company.
5. Quantitative techniques Theory & Problems – P.C.Tulsian, Vishal Pandey, Pearson Education Asia.
6. Complex variables and applications – Churchill and Brown, McGraw-Hill.
7. Operations research – Panneer Selvam, PHI
8. Engineering Mathematics vol III – S.Arumugam, A.T.Isaac, Somasundaram, Scitech publications
9. Advanced Mathematics for Engg.students vol III –S.Narayanan, T.K.M.Pillay, G.Ramanaigh, S.Vishwananthan printers & publishers.

MANUFACTURING PROCESSES

M 502 **3+1+0**

Module 1

Patterns: - pattern allowances and materials-moulding-core and core prints-types of cores- pattern construction-layout and colour coding-tools-processes-moulding sand constituents, types and testing-moulding machines-moulding procedure-sand conditioning-gating system-cupola operation-pouring and cleaning of castings-defects in castings-inspection and quality control-casting machines-design of dies-centrifugal, continuous, investment, squeeze casting and shell- mould casting- - comparison of casting with other production processes.(include necessary figures)

Module 2

Welding: - definition-metallurgy of welding-applications – classification - mechanism-processes-gas welding - details, equipment, fluxes and filler rods - design effect of weld parameters on weld quality-flame cutting-ISI specification for welding. Arc welding applications-equipment –polarity-governing factor in fusion welding-electrodes and types-ISI specification for electrodes –Welding design-butt joint-TIG-GMA-CO_2 process. Submerged arc, electroslag plasma arc and flux cored arc welding-resistance, thermit solid state, electron beam and laser welding.Brazing: soldering-explosive welding-inspection and defects in welding-welding of plastics.(include necessary figures)

Module 3

Rolling: - principles-types of rolls and rolling mills-semifinished and rolled products- rolling of tubes, wheels, axles, I-beam-thread and gear rolling-friction and lubrication in metal forming-hot and cold rolling-rolling machines-heating and cooling in rolling-strip velocity and roll velocity-roll and roll pass design - Theories of rolling and effect of parameters-load calculation-High velocity forming - energysources - material behaviour - pneumatic, mechanical, electrohydraulic, electromagnetic, and explosive forming.

Module 4

Press working: - types of presses and pressworking operations involving shearing, bending, drawing, squeezing-Extrusion: - methods, machines-analysis of rod extrusion-Wire and wire drawing operations-analysis-die angles-simple, progressive and compound dies-plastic and rubber processing-Calendering-transfer, injection and compression moulding.

Module 5

Forging: -classification-process-equipments-drawing, deep drawing, punching, blanking- tube piercing-spinning and coining-elastic and plastic deformation-hot forging, die forging- machinery for forging-operation-heating in forging-manufacture of drop forging dies, presses-design of forgings and dies-upsetting-

forging defects-forging analysis-quality assurance for forging-non destructive testing.

References

1. Workshop Technology - Raghuvanshi
2. Manufacturing Engineering & Technology - S.Kalpakjian and S.A.Schmidt
3. Manufacturing Processes - Begeman
4. Manufacturing Science & Technology; Vol. I - Suresh Daleela
5. Processes and Materials of Manufacture - Roy A.Lindberg

COMPUTER PROGRAMMING

M503 **2+2+0**

Module 1

Introduction to C language – character set – operators – constants and variables – data types – use of built in I/O functions - use of control statements if, if – else, for, while, do-while and switch – use of logical AND, OR and NOT – pre-processor directive - writing summation of various mathematical series like e^x, sin(x), cos(x) etc.

Module 2

Arrays – declaration of one dimensional array and its handling – bubble sorting – quick sorting – searching – string handling functions – multidimensional arrays and its handling – structure and union – array of structures – sorting of strings – programs

Module 3

Functions – declaration – global and local variables - call by value method – writing different string handling functions – storage classes – passing an array to a function – passing a structure to a function – recursion - macros – programs

Module 4

Declaration and use of pointers – call by reference method – pointer to an array –

pointer to a structure – array of pointers – pointer to an array – self-referential

structure – dynamic memory allocation – linked lists – programs

Module 5

Different types of files – reading writing and appending of text and binary files – other various file handling functions - transfer of data in blocks - command line arguments – use of bit-wise AND, OR and NOT.

References

1. Programming with C – Schaum's series
2. Programming in C – Balaguruswamy
3. The C Programming Language – Kerningham & Ritchie
4. Let us C – Yaswant Kanetkar
5. Programming with ANSI and Turbo C – Kamthane, Pearson

THEORY OF MACHINES - II

M 504 **2+2+0**

Module 1

Static force analysis: - force couples-condititons for equilibrium-free body diagram- analysis of four bar chain-force analysis of slider-crank mechanism-Coulomb friction.

Dynamic force analysis: - D'Alemberts principle-inertia forces-dynamic force analysis of four bar chain, and slider crank mechanism.

Module 2

Governors: - terminology; Watt, Porter, Proel, Hartnell, Hartung, Wilson-Hartnell, and Pickering governors-spring controlled governors of gravity type-effort and power-controlling force diagram-quality of governors-effect of friction-insensitiveness-stability-inertia governors- governor speed, torque characteristics of an engine-governor and flywheel.

Module 3

Turning moment diagram and Flywheel: - coefficient of fluctuation of energy and speed- energy saved in a flywheel-punching press-dynamically equivalent two mass system-centre of percussion-kinetic equivalence-reversed effective force analysis-piston effort-crankpin effort- crank effort-turning moment diagrams for steam and I.C. engines.

Module 4

Gyroscope: - principle-angular acceleration-effect of gyroscopic couple on bearings, airplanes, and ships-stability of automobile and two wheel vehicles-gyroscopic stabilization of sea vessels and grinding mills.

Gear trains: -simple, compound-epicyclic trains with coaxial shafts.

Module 5

Cams and Followers: - types-follower motion-SHM-uniform velocity and acceleration- cycloidal - displacement, velocity and acceleration curves-cam profile-reciprocating and oscillating followers-tangent cams-convex and concave cams with footed followers.

References

1. Mechanism and Machine Theory - Ambedkar
2. Theory of Mechanism and Machines - A.Ghosh & A.K.Mallick
3. Theory of Machines - V.P.Singh
4. Theory of Machines - P.L.Ballaney
5. Theory of Mechanism and Machines - Joseph Shigley
6. Dynamics of Machinery - Holovanco

MECHATRONICS AND CONTROL SYSTEMS

M 505 **2+2+0**

Module 1

Introduction: - Scope of Mechatronics-systems-microprocessor based controllers-mechatronic approach-sensors – transducers - force-velocity – displacement - temperature-inputting data by switches-signal coditioning - operational amplifiers-filtering-multiplexers-data acquisition- modulation. Data presentation systems: - displays-measurement systems-calibration-pneumatic and hydraulic systems-control valves-actuators-mechanical and electrical actyation systems-relays and solenoid switches and proximity pickups.

Module 2

Input/Output systems: - ports, interface requirements-adaptors-programmable

logic controllers-data-handling- digital communications-system, networks,

protocols, interfaces, fault finding-design and mechatronics-design solutions.

Electromechanical systems: CD, DVD ROMs, OCR, Printers-Medical devices: Artificial internal organs-Diagnostic and Therapeutic EMDs.

Module 3

Introduction to Control systems Engineering:- concept of automatic control-open loop and closed loop systems-servomechanisms-block diagrams-transfer functions. Representation of control components and systems-Translational and

rotational mechanical components-series and parallel combinations-comparators, integrating devices, hydraulic servomotors, temperature control systems, and speed control systems.

Module 4

System response: - First and Second order system response to step, pulse, ramp, and sinusoidal input-systems with distance, velocity lag. Control system analysis: - Transient response of simple control systems-Stability of control systems-Routh stability criteria- error analysis.

Module 5

Frequency response analysis: - polar, rectangular and logarithmic plots-experimental determination of frequency response-Bode, and Nyquist stability criteria-Gain and phase margin. Root locus of simple transfer functions-transient response from root locus.

References

1. Mechatronics - W.Bolton, Pearson
2. Understanding Electromechanical Engineering - Lawrence J.Kamm
3. Mechatronics - Dan S. Necsuleseu, Pearson
4. Control System Engineering - T.J.Nagrath and M.Gopal
5. Automatic Control Theory - Ravan
6. Modern Control Engineering - Katsuhiko Ogata
7. Control Systems - A.Nagoor Kani
8. Modern Control Engineering - Dorf, Pearson

THERMAL ENGINEERING - I

M 506 **2+2+0**

Module 1

Steam Engineering: Properties of steam - wet, dry and superheated steam - dryness fraction - enthalpy and internal energy - entropy of steam - temperature entropy diagram - process - Mollier chart - Rankine cycle for wet, dry and superheated steam. Steam Generators - classification - modern steam generators - boiler mountings and accessories.

Module 2

Steam nozzles - Mass flow rate - throat pressure for maximum discharge - throat area - effect of friction - super saturated flow.

Steam turbines: velocity triangles, work done, governing, and efficiencies.

Module 3

Gas turbine Plants - Open and closed cycles - thermodynamics cycles - regeneration, re heating - inter cooling - efficiency and performance of gas turbines. Rotary Compressors - Analysis of rotary compressors - centrifugal and

axial compressors. Combustion - combustion chambers of gas turbines - cylindrical, annular and industrial type combustion chamber - combustion intensity - combustion chambers efficiency - pressure loss combustion process and stability loop.

Module 4

Introduction to solar energy - solar collectors - Liquid flat plate collectors - principle - thermal losses and efficiency - characteristics - overall loss coefficient - thermal analysis - useful heat gained by fluid - mean plate temperature - performance - focussing type solar collectors - solar concentrators and receivers - sun tracking system - characteristics - optical losses - thermal performance - solar pond - solar water heating - solar thermal power generation (Description Only)

Module 5

Thermal power plants: layout and operation of steam and diesel power plants - coal burners - stockers - cooling ponds & towers - chimneys - draught - dust collectors - precipitators - feed water heaters - evaporators - steam condensers - coal handling - ash handling.

References

1. Power plant technology - E. L. Wahid
2. Thermodynamic and heat power engineering - Mathur and Mehta
3. Thermal Engineering - P. L. Ballaney
4. Gas Turbine Theory - Cohen & Rogers
5. Solar Energy Utilization - G. D. Rai
6. Thermal engineering - R.K. Rajput.

COMPUTER LABORATORY

M 507 **0+0+3**

a) Familiarization of operating systems. Use of file directories, editors, compilers and file managers etc.
b) Familiarization of Word processing packages – editing, formatting and printing
c) Familiarization with spread sheet packages for graphical representation of data
d) Introduction to computer aided drafting – drawing simple objects
e) Programming experiments in C to cover control structures functions, arrays, structures, pointers and files

Examples: -

i. Counting characters, lines and words

ii. Checking leap year
iii. Finding sum of digits and reversing a number
iv. Generating Prime numbers, Fibonacci numbers and Angstrom numbers
v. Sine and Cosine series
vi. Sorting of numbers, strings and records
vii. Matrix addition and multiplication
viii. Implementation of dynamic memory allocation
ix. Implementation of linked lists
x. File handling
xi. Problems using Command line arguments

MACHINE TOOL LABORATORY

M 508 **0+0+3**

Study of Centre Lathe: Origin of the name lath and lathe- specification of lathe- head stock, tail stock, carriage, cross slide, compound rest, guide ways, feed gar box, apron box, micro structural requirement of bed material. Accessories: Chuck, two and three jaws, and faceplate, follow rest, tool post grinder, and centres.

Study of Machining technology: Study of metal cutting – tool terminology as per ASA, ISO, DIN standards –merchant's circle, Lee & Shaffer theory, thick & thin zone models - tool materials, coated HSS, ceramic, CBN, diamond etc, inserts, chip breakers -- Tool wear mechanisms, VB determination - Use of Taylor's equation at shop floor - Machineabilty index - Role of specific heat in cutting fluids. – Cutter types and selection – Abrasive machining (Ra values) – Diamond turning of parts (Ra values) - Production of axi – symmetric parts – Production of prismatic components – Hole machining – Gear machining.

Study of Basic measurement and devices: accuracy, precision, sensitivity, and standards of measurements, metrology lab; standard and calibration, linear measurements, limit gauges (types and design), Taylor's principle, comparators (optical, mechanical, electrical, pneumatic), slip gauges, optical projector with digital measuring. – Geometrical measurements: angular measurements, vernier and optical protractors, sine bar. - Measurement of light wave interference, flatness and parallelism and round measurement, checking the dimensional accuracy of slip gauges with interference microscope. - *Surface characterization*: measurement of surface finishes RMS and CLA values, waviness, cut off, skid, instruments for measurement of roughens of a sand cast surface, slip gauge surface, ground bore of an engine cylinder, importance of surface finish on crack initiation. – *Screw thread terminology*, best wire size, two and three wire methods pitch measurement – Gear metrology (spur gear): run out checking, composite errors, base pitch measurement, profile measurement, checking backlash, alignment errors. – *Advanced measuring devices:* CMM, machine vision, toolmakers microscope, limitations, SEM, & TEM, laser measuring instruments, laser micrometer and alignment test using laser interferometry.

Experiments

Measurement of cutting forces in machine tools using dynamometers –process capability study of Machines –grinding of tool angle using tool and cutter grinding machine in a tool room –Turning & taper turning, turning & thread cutting, - Indexing & Gear cutting, pocket milling— Study of tool and machine monitoring systems.- Angular measurements use of sine bar and slip gauges, measurement of angle using clinometer, bevel protractor – calibration of plug and snap gauges using slip gauges – Roundness measurement : cylindricity, concentricity, perpendicularity using dial stand and measuring bench – Surface finish measurement.- Optical profile projector: study of profile of gear tooth, screw threads, other tools – Tool makers microscope: to study tool geometry, screw threads, measurement of turning tool wear of VB & KT values –Flatness measurement of surface table using auto collimator – Lathe alignment test using laser interferometer – gear concentricity tester, gear roll tester and gear tooth measurement.

Student's assessment, continuous evaluation, awarding of sessional marks, record bonafides, oral examination etc and university examination shall be done by Faculty members.

References

1. Acharkan. N. -Machine Tool Design Vol. 1 to 4, MIR Publication.
2. HMT- Production Technology, TMH.

SIXTH SEMESTER

MECHANICS OF MATERIALS

M 601 **2+2+0**

Module 1

Definition of stress and strain – components of stress and strain – Hook's law – Plane stress and strain – stress at a point – measurement of strain – strain rosette – Mohr's circle of strains – differential equations of equilibrium – boundary conditions – compatibility equations – stress functions – 2D problems in rectangular co-ordinates – solutions by polynomials of various degrees and effects – Saint Venant's principle – determination of displacements.

Module 2

3D stress and strain – principal stresses – strain ellipsoid and director surfaces – stress invarients – determination of maximum and minimum shearing stress – homogeneous deformation – strain at a point – principal axes of strain – principal strain and invarients of strain – differential equations of equilibrium – boundary conditions – conditions of compatibility – determination of displacements – strain energy – uniqueness of solutions.

Module 3

2D problems in polar co-ordinates – general equations in polar co-ordinates – stress distribution symmetrical about an axis – pure bending of curved bars – strain components in polar co-ordinates – displacements for symmetrical stress distributions – rotating disk with and without central hole – disk of uniform strength.

Module 4

Thick cylinders – spherical shells – compound cylinders –rotating rims and cylinders – long cylinders.

Module 5

Curved beams – bending by eccentric loading – crane hooks – c clamp – chain link – columns of machine tools. Photo elastic techniques of study of stress – description only.

References

1. Theory of Elasticity - Timoshenko & Goodyear
2. Advanced Mechanics of Materials - Seelv & Smith
3. Advanced mechanics of Solids - L.S.Srinath
4. Mechanics of Solids - Lardner & Archer
5. Introduction to Mechanics of Solids - Ezer P.Popov
6. Mechanics of solids - Mubeen, Pearson

METROLOGY AND INSTRUMENTATION

M 602 **3+1+0**

Module 1

General measurements concepts: Principles for achieving accuracy; Methods for estimating accuracy and precision, precision Vs accuracy, systematic and constant errors; progressive, random, erratic, drunken errors; statical concepts in metrology, statcial analysis of measurement data, control chart techniques – comparators – *General principle of measurements*: line & end measurements, standards; linear measurements, basic units, and quantities for displacement, mass, time, temperature & optics; systems of limits and fits; selecting & assigning of fits, tolerances for linear dimensions.

Module 2

Gauges: classification, design of gauges, gauge maker's tolerances, wear allowance, gauges materials & gauge manufactures. *Form measurements*: straightness, flatness, squreness, circularity & cylindricity – Measurement of angles & tapers: sine bars, angle gauges: auto collimator, clinometer & spirit level; taper gauges, bevel protractors.

Module 3

Measurement of surface finish: surface structure, integrity, texture, roughens, waviness, lay, cut off, RMS & CLA values, roughness values produced by machining processes, instruments for different surface finish measurements, concept of apparent to real area of contact of mating surfaces, applications in clutch plate surface, brake liner, inner race of a bearing, cylinder liner, machine tool guide way, surface to be painted etc & importance of surface finish on crack initiation. *Optical measuring instruments*: interferometry, optical flats, optimeters, and optical projectors, tool maker's microscope, limitations, SEM & TEM.

Module 4

Advanced measuring devices: Laser interferometry, applications – computer controlled co-ordinate measuring machine; machine vision & non contact CMM - *Gauging and measurements of screw threads*: Gauging methods for manufacturing, screw thread terminology, standard specification, and formulae, tolerance, thread gauge measurement, measuring equipment, application of thread gauges – *Measuring of gears*: Measuring methods for runouts, pitch profile, lead, backlash, tooth thickness, composite elements, inspection equipment.

Module 5

Generalized measurement system: measurement terminology, input, out put configurations, static characteristics, errors in measurement, drift, noise, accuracy,

precision static sensitivity and resolution, loading effects on instruments- *Detector transducer elements*: principles of calibration, applications in measurement of strain, types of strain gauges, application in measurement of load & torque, measurement of force and torque, hydraulic, pneumatic & train gauge type load cells, hydraulic & electric dynamometers, measurement of vibration, vibrometers & accelerometers, theory of seismic instruments - *Temperature measurement*: Use of Bi metals, pressure thermometer thermocouple, optical & radiation pyrometer – magnetic flow meter – thermal conductivity gauges.

References

1. ASME - Hand book of industrial Metrology
2. *Beckwith* - *Mechanical measurements, 5/e, Pearson*
3. Doeblin - Measurement systems, 4/e, McGraw- Hill
4. Hume - Metrology, McDonald
5. Sharpe - Metrology, ELBS
6. Taher - Metrology, ELBS

THERMAL ENGINEERING - II

M 603 **2+2+0**

Module 1

Working of two stroke & four stroke - Petrol and Diesel Engines (Review Only) - valve timing diagrams - Fuels - Chemical structure - qualities, ratings of fuels - Alternative fuels, Alcohol, vegetable oils, biogas.

Types of Engines - Wankel E/n, Stirling E/n, Stratified charge e/n, VCR E/n, free piston E/n. Fuel air cycle (actual) for petrol and diesel engines - variation of specific heats - heat losses - Dissociation

Module 2

Carburation - Air fuel mixture requirements - stoichiometry and excess air calculations - types of carburetors - Fuel injection systems - classifications - fuel injection pump - nozzle - direct and indirect injection - Injection in S. I. Engine - M. P. F. I. System - Ignition system - Battery & Magneto type - firing order - Ignition timing and spark advance_- Lubrication systems - types - properties of lubricants - additives for lubricants - Heat rejection and cooling - Theory of engine heat transfer - types of cooling system - Air and liquid system - Super charging & turbo charging.

Module 3

Combustion in S. I. E/n - Ignition limits - stages of combustion - combustion quality - Ignition lag - Flame propagation - Abnormal combustion - detonation - effects - Theory, chemistry and control - flash point, fire point & viscosity index - combustion chamber design considerations.

Module 4

Combustion in C. I. Engines - Air Fuel ratio in C. I. Engines - Ignition Lag - diesel knock - Controlling Methods - Various stages of combustion - vaporization of fuel droplets and spray formation - Air motion - Swirl - combustion chamber - design considerations.

Module 5

Pollutant formation and control in S. I. And C. I. Engine, Nox, CO, Unburned hydro Carbon and particulate - Exhaust gas treatment - catalytic converter - Thermal reaction - Particulate Trap.

Engine operating characteristics - Testing of I. C. Engines - Indicated power - Brake power - Volumetric Efficiency - Heat balance Test - Morse Test - Measurement of exhaust smoke and exhaust emission.

References

1. Internal Combustion Engine Fundamentals - John B. Heywood
2. Internal Combustion Engine and Air Pollution - Obert E. F.
3. Internal Combustion Engine - Lichty L. C.
4. Internal Combustion Engine - V. Genesan
5. A course in internal combustion Engine - Mathur and Sharma.

HEAT AND MASS TRANSFER

M 604 **2+2+0**

Module 1

Introduction to basic modes of heat transfer - Scope and application of heat transfer principles in engineering practice. Conduction Fourier law - thermal conductivity of solids, liquids and gases - factors affecting thermal conductivity. Thermal heat, conducting equation in Cartesian, cylindrical and spherical co-ordinates - one dimensional steady state conduction with and without heat generation - unsteady state conduction. Conduction through homogenous and composite surfaces plane wall cylindrical and spherical - variable thermal conductivity shape factors - heat flow through corners and edges.

Module 2

Convection - Newton's law - concept of boundary layer - significance of Prandtil number - boundary layer equation - flat - plate heat transfer equations by integral method Laminar and turbulent flow of heat transfer in tubes - Forced convection in turbulent flow - Reynolds analogy. Application of dimensional analysis in forced and natural convection. empirical relations, Combined effect of convection and conduction. Over all heat transfer coefficient - critical radius of insulation.

Module 3

Heat Exchangers type of heat exchangers. Log mean temperature difference.

Design of shell and tube exchangers - NTU method of evaluation of heat

exchangers - heat exchange - effectiveness - application of straight rectangular and triangular fins effectiveness of fins.

Module 4

Radiation - Nature of thermal radiation - Definitions and concept - Monochromatic and total emissive power - Absorptivity - Reflectivity transmissivity, Black Grey and Real surfaces. Concept of Black body Planks distribution law - Kirchoffs law Wein's displacement law-Geometric factors of simple configuration. Heat exchange by radiation between black surfaces - Large parallel black plate - equal parallel and opposite black squares, discs, black rectangles perpendicular to each other having a common edge-heat exchange by radiation between large parallel planes of different emissivity (no derivations - simple problems with the use of chart and equations)

Module 5

Mass transfer - introduction to mass transfer - Pick's law of diffusion in gases. Diffusion coefficient. Analogy between the phenomena of heat transfer and mass transfer. Elementary problems. Condensation and boiling - film Drop-wise condensation-film boiling and pool boiling. Bubble growth and collapse-empirical relations for heat transfer with change of phase (description only) Numerical methods in conduction (finite difference and finite element methods description only).

References

1. Elements of Heat Transfer - Jacob Hawkins
2. Principles of Heat Transfer - Krieth
3. Heat and Mass Transfer - Fckert & Drake
4. Heat transfer - Holmann
5. Engineering Heat & Mass Transfer - R.K. Rajput.
6. Engineering Thermodynamics and Heat Transfer - Gupta and Rajendra Prasad

PRINCIPLES OF MANAGEMENT AND ENGINEERING ECONOMICS

M605 **3+1+0**

Part A – Principles of Management

Module 1

Functions of management: planning, organizing, staffing, directing, motivating, communicating, controlling and coordinating – Organizational structure-line, staff and functional relationship-span of control and delegation.

Module 2

Ogranisational behaviour: stress, meaning, causes, effects, strategies for coping with stress-motivation-types of motives, theories of work motivation-group dynamics-nature of work group, group cohesiveness, group performance, group norms. Marketing management: identification of products, pricing, promotion and distribution channels.

Module 3

Formation of companies: proprietary and partnership-joint stock, private limited, public limited companies-private sector, public sector, joint sector and co-operative sector.

Wages and incentives: Time and piece rate system, bonus, incentives-monetary and non-monetary Total quality management-re-engineering-management by objectives

Part B – Engineering Economics

Module 4

Basic concepts: Theory of demand and supply-price mechanism-factors of production-land, labour, capital and organization-national income-difficulties in estimation-taxation-direct and indirect-progressive and regressive-black money-inflation-demand pull and cost push-effects of price increases.

Module 5

Indian financial system: Reserve bank of India-commercial bank system-public sector banks-development financial institutions-IDBI, ICICI, SIDBI, IRBI-

investment institutions-UTI-insurance companies-stock market-functions-problems faced by the stock markets-role of the public sector-privatisation-multinational corporations and their impact on the Indian economy.

References

1. Benga & Sharma – Industrial Organisation and Management
2. Fred Lufthans – Organisational Behaviour
3. Keith Davis – Human Behaviour at Work
4. Philip Kotler – Marketing Management
5. K.K.Dewett – Modern Economic Theory
6. A.N.Agarwal – Indian Economy
7. Kargaweski – Operation management, Pearson
8. Mazda – Engineering management, Pearson
9. O.P.Khanna - Industrial Engineering & Management

COMPUTER AIDED DESIGN AND MANUFACTURING

M 606 **3+1+0**

Module 1

Evolution of CAD/CAM and CIM segments of generic CIM, computers and workstation, elements of interactive graphics, input/ out put display, storage devices in CAD - an overview of CIM software - 2D Graphics: line drawing algorithms, DDA line algorithm – circle drawing, bressnham`s circle drawing algorithm– 2D translation, rotation, scaling – clipping -3D Graphics (basic only).

Design process – CAD process: wireframe, surface, solid modeling; Engineering analysis; design review & evaluation, automated drafting – CAD hard ware, software, data presentation, CAD software packages

Module 2

Numerical control: Need - advantages & disadvantages – classifications – Point to point, straight cut & contouring positioning - incremental & absolute systems – open loop & closed loop systems – DDA integrator & Interpolators – resolution – CNC & DNC.

Programmable logic controllers (PLC): need – relays- logic ladder program – timers - Simple exercises only.

Devices in N.C. systems: Driving devices - feed back devices: encoders, moire fringes, digitizer, resolver, inductosyn, tachometer.

Module 3

NC part programming: part programming fundamentals - manual programming – NC co-ordinate systems and axes – tape format – sequence number, preparatory functions, dimension words, speed word, feed world, tool world, miscellaneous functions – programming exercises.

Computer aided part programming: concept & need of CAP – CNC languages – APT language structure: geometry commands, motion commands, postprocessor commands, compilation control commands – programming exercises – programming with interactive graphics.

Module 4

Automated process planning: Process planning, general methodology of group technology, code structures of variant & generative process planning methods, AI in process planning, process planning software.

Module 5

Robotics: Industrial robots and their applications for transformational and handling activities, configuration & motion, actuators, sensors and end effectors, feature like work envelop, precision of movement, weight carrying capacity, robot programming languages.

Vision systems: introduction to intelligent robots.

References

1. Craig john - Introduction to Robotics
2. Groover M.P. - CAD/CAM, PHI.
3. Hearn & Baker - Computer graphics (in C version), Prentice Hall.
4. New man & Sproull - Principles of interactive Graphics, McGraw – Hill.
5. Petruzella Frank.D. - Programmable logic controllers.
6. Yoram koren - Numerical control of machine tools, McGraw-Hill
7. Jonn Craig - Introduction to Robotics

HEAT ENGINES LABORATORY

M 607 **0+0+ 3**

Study of systems and components of IC Engines and automobiles - study of dynamometers used in engine testing - study of IC Engine repairs and maintenance. Study of boilers, boiler mountings and accessories - study of steam engine parts and systems.

Testing of IC engines • Performance analysis of IC engine using computerized test rig-Load test on petrol and diesel engines- determination of indicated and brake thermal efficiencies - mechanical efficiency - relative efficiency - volumetric efficiency - air-fuel ratio and compression ratio - valve timing diagram - retardation test - Morse test - heat balance - effect of varying the rate of cooling water and varying the speed on the performance characteristics of engines. Testing of steam boiler - boiler trial - steam calorimeters and steam nozzles - performance test on steam engines - performance test on steam turbines.

Testing of fuels and lubricants - determination of flash and fire points of petroleum products - determination of kinematics and absolute viscosity of lubricating oils - determination of calorific

ADVANCED MACHINE TOOL LABORATORY

M 608 **0+0+3**

Study of Vibration: two and multi degree freedom systems, signature analysis and preventive maintenance, noise control. Study of Automated process planning: process planning, general methodology of group technology, code structures variant generative process planning methods, AI in process planning.

Study of Quality circle concepts – ISO 9000, ISO 4000 series, QS 9000 – quality system standards, TQM, - SQC, control charts for inspection, charts for variables, R charts, six sigma concepts – Taguchi methods.

Study of Fundamentals of Numerical control: principles of NC - incremental & absolute positioning, PTP, straight & contouring machining, open & closed loop system - DDA integrator & different interpolators - feed back devices - lead screw - stepper motor - advantages & disadvantages - NC, CNC and DNC - punched tapes – manual part programming, preparatory function, G codes, speed word, feed word, M codes, tool word etc, computer aided part programming, APT languages – tooling for CNC, tooling systems, automatic tool changing tool magazines etc - principles, need of machining centers. *Study of Programmable logic controllers (PLC):* need – relays- logic ladder program – timers; on & off delay timers, cascading & retentive timers – counters; cascading counters. *Study of Tolerance charting techniques*: operational sequences for typical shaft type components, preparation of process drawing for different operation, tolerance worksheets and centrality analysis. *Study of Design of jigs and fixtures*: degree of freedom - principles of location and clamping - principles of jig design – fool proofing - elements of jigs - design of jigs for drilling, reaming – principles of fixture design, locators and different types of clamps – elements of fixture – provision for tool setting – design of fixture for milling, turning, boring, and grinding operations, inspection of assembly fixtures – modular fixturing – concepts and applications – use of software for building fixture – tool design for forging, drop forging dies and auxiliary tools – upset or forging machine dies. *Study of Design of sheet metal blanking and piercing dies*: Die design – power press types – die clearances – cutting forces – punch and die mountings – types of construction – fine blanking – die design fundamentals – materials for dies & allied elements – multiplexing of tools.

Experiments

Key way slotting, side & face milling of a rod to make square head – 5mm material removal by Shaping – Drill 10.5 mm. CBR 16 mm, 10 mm deep – Surface grinding, cylindrical grinding and tool grinding - Vibration study of machine tools with an analyser. Preparation of process plans using CAPP software –Planning of experiments for process improvement using software – simulation of factory layout - facilities layout analysis – line balancing – materials requirement planning – inventory analysis – quality assurance using control charts – preparation of process sheet for manufacturing of spindle like & housing type component – preparation of process plan & cost estimation for the manufacture of typical product like submersible pump, three phase motor etc.

Preparation of CNC programs for drilling, grooving, parting, linear interpolation, circular interpolation, etc. – Simulate and produce a component has valley shaped undercuts along its lenth, etc. PLC operated solenoid valves. Design of a jig and a fixture for drilling & milling operation - Design of assembly, inspection, fixtures - Design of sheet metal working dies: feed strip layout design, force calculations, press tool design (forming & cutting), assembly & dismantling of simple die casting dies - Design & fabrication of simple bending dies – Design of forging dies: product requirement & design of forging dies – study of analysis software for mould flow, melt flow, metal forming.

Student's assessment, continuous evaluation, awarding of sessional marks, record bonafides, oral examination etc and university examination shall be done by Faculty members.

References

1. Acharkan. N. - Machine Tool Design Vol.1 to 4, MIR Publication.
2. HMT - Production Technology, TMH.
3. Petruzella Frank. D - Programmable logic controllers.
4. Yoram Koren - NC machines tools, McGraw Hill**.**

SEVENTH SEMESTER

GAS DYNAMICS AND JET PROPULSION

M 701 **2+1+0**

Module 1

Introduction to gas dynamics: control volume and system approaches acoustic waves and sonic velocity - Mach number - classification of fluid flow based on mach number - mach cone-compressibility factor - General features of one dimensional flow of a compressible fluid - continuity and momentum equations for a control volume.

Module 2

Isentropic flow of an ideal gas: basic equation - stagnation enthalpy, temperature, pressure and density-stagnation, acoustic speed - critical speed of sound-dimensionless velocity-governing equations for isentropic flow of a perfect gas - critical flow area - stream thrust and impulse function. Steady one dimensional isentropic flow with area change-effect of area change on flow parameters-chocking- convergent nozzle - performance of a nozzle under decreasing back pressure -De lavel nozzle - optimum area ratio effect of back pressure - nozzle discharge coefficients - nozzle efficiencies.

Module 3

Simple frictional flow: adiabatic flow with friction in a constant area duct-governing equations - fanno line limiting conditions - effect of wall friction on flow properties in an Isothermal flow with friction in a constant area duct-governing equations - limiting conditions. Steady one dimensional flow with heat transfer in constant area ducts- governing equations - Rayleigh line entropy change caused by heat transfer - conditions of maximum enthalpy and entropy

Module 4

Effect of heat transfer on flow parameters: Intersection of Fanno and Rayleigh lines. Shock waves in perfect gas- properties of flow across a normal shock - governing equations - Rankine Hugoniat equations - Prandtl's velocity relationship - converging diverging nozzle flow with shock thickness - shock strength.

Module 5

Propulsion: Air craft propulsion: - types of jet engines - energy flow through jet

engines, thrust, thrust power and propulsive efficiency turbojet components-

diffuser, compressor, combustion chamber, turbines, exhaust systems.

Performance of turbo propeller engines, ramjet and pulsejet, scramjet engines.

Rocket propulsion - rocket engines, Basic theory of equations - thrust equation -

effective jet velocity - specific impulse - rocket engine performance - solid and liquid propellant rockets - comparison of various propulsion systems.

References

1. Compressible fluid flow - A. H. Shapiro
2. Fundamentals of compressible flow with aircraft and rocket propulsion - S. M. Yahya
3. Elements of gas dynamics - Liepman & Roshko
4. Aircraft & Missile propulsion - Zucrow
5. Gas dynamics - M.J. Zucrow & Joe D.Holfman

INDUSTRIAL ENGINEERING

M 702 **2+1+0**

Module 1

Introduction: Evolution of Industrial Engineering- Fields of application of Industrial Engineering -Functions of Industrial Engineer-Organisational structure of Industrial Engineering Department.

Production and Productivity: Types of production-continuous production-intermittent production. Productivity-productivity index-factors affecting productivity-techniques for productivity improvement.

Value Engineering: Historical perspective-reasons for poor values-types of values-the different phases of value analysis-applications of value analysis.

Module 2

Plant design: Plant location-factors influencing plant location. Plant layout-types of plant layout-introduction to layouts based on group technology, just in time and cellular manufacturing systems.

Material handling: Principles of material handling-selection of material handling devices-types of material handling equipments.

Maintenance and replacement of equipments: Types of maintenance. Depreciation-methods of calculating depreciation. Selection of equipments-methods for replacement studies.

Module 3

Methods Engineering: Process charts and flow diagrams-Micro motion study-Work measurement techniques.

Job evaluation and merit rating: Objectives of job evaluation-Methods of job evaluation. Objectives and uses of merit rating-Merit rating plans.

Module 4

Industrial relations: Fatigue-Communication in industry-Industrial disputes-Trade unions-Quality circles-BIS-ISO-Labour welfare-Industrial safety-Statutory provisions in labour legislations.
Ergonomics: Objectives and applications.

Module 5

Inventory control: Determination of Economic order quantity and reorder level.
Quality control: Destructive and nondestructive testing methods. Statistical quality control-process control charts-acceptance sampling.
Cost accounting and control: Elements of cost- Selling price of a product-Types of cost-Allocation of overheads.

References

1. Production system - Riggs
2. Production control - Hiejet
3. Human factors in Engg design - Mc Cormic E.J.
4. Industrial Engg & Management - O.P.Khanna
5. Industrial Organisation & Management - Banga & Sarma
6. Industrial Engg - A.P.Verma
7. Value Engg - Mudge
8. Manufacturing organization & Management - Amrine
9. Time & Motion Study - Lowry
10. Quality Control - Hansen

REFRIGERATION AND AIR CONDITIONING

M 703 ***2+1+0***

Module 1

Principles of refrigeration: Thermodynamics of refrigeration - Carnot cycle, reversed carnot cycle, heat pump, and refrigerating machine- coefficient of performance - unit of refrigeration - refrigeration methods- conventional refrigeration systems. Air refrigeration system- Bell Coleman cycle - C.O.P. capacity work and refrigerant flow requirements in Bell - Coleman cycle.

Module 2

Vapour compression system: simple cycle -comparison with Carnot cycle - theoretical, actual and reactive - COP effect of operating parameters on COP - wet, dry and superheated compression - under cooling - actual cycle representation on TS and PH diagrams simple problems. Advanced vapour compression systems - multistage vapour compression systems - flash chamber multiple compression and evaporation systems cascading - simple problems.

Module 3

Vapour absorption systems: simple, cycles - actual cycle - ammonia water and lithium bromide water systems - COP - electrolux system. Refrigerant and their properties: Nomenclature - suitability of refrigerants for various applications - unconventional refrigeration methods- Vortex tube, steam-jet, magnetic (cryogenics) refrigeration and thermoelectric refrigeration - applied refrigeration house hold refrigerators - unit air conditioners and water coolers - ice plant cold storage.

Module 4

Refrigeration system components: condensers - water and air cooled condensers - evaporative condensers - expansion devises - capillary tube- constant pressure expansion valve - thermostatic expansion valve - float valve and solenoid valve - evaporators - natural convection coils - flooded evaporators - direct expansion coils. Reciprocating compressors: single stage and multistage compressors - work done optimum pressure ratio- effect of interfolding - volumetric efficiency -effect of clearance - isothermal and adiabatic efficiency - compressed air motors. Rotodynamic compressors: Screw and vane type compressors - principle of operation - hermetic, semihermetic and open type refrigeration compressors.

Module 5

Principles of air conditioning: Psychrometry and psychrometric chart

thermodynamics of human comfort - effective temperature - comfort chart

applied psychrometry - sensible heat factor - psychometric process-problems.

Winter air conditioning: heating load calculations humidifiers and humidistat.

Summer air conditioning: cooling load calculations - year round air conditioning -

unitary and central systems - principles of air distribution - design of air duct

systems.

References

1. Refrigeration and air conditioning - Ballaney P. L.
2. Refrigeration and air conditioning - Stocker W. F.
3. Refrigeration and air conditioning - Jordan and Protester
4. Principles of Refrigeration - Roy J. Dossat

DYNAMICS OF MACHINERY

M 704 **2+1+0**

Module 1

Balancing: - Balancing of rotating masses, static balancing and dynamic balancing, Balancing of several masses rotating in same plane, Balancing of several masses rotating in several planes, Balancing machines.

Balancing of reciprocating masses: - The effect of inertia force of the reciprocating mass on the engine. Partial primary balance. Partial balancing of locomotive, Hammer blow, Variation of tractive effort, Swaying couple. Coupled locomotives, Balancing of multi cylinder inline engines, v-engines, Radial engines, Direct and Reverse cranks

Module 2

Vibrations: - Definitions, simple harmonic motion.

Single degree freedom systems: -

Undamped free vibrations: - Equations of motion Natural frequency, Energy method, Equilibrium methods, Rayleigh's methods, Equivalent stiffness of spring combinations.

Damped free vibrations: - Viscous damping, Free vibrations with viscous damping, over-damped system, critically damped system, under-damped system, Logarithmic decrement, viscous dampers, coulomb damping.

Forced Vibrations: - Forced harmonic excitation Rotating unbalance, Reciprocating unbalance. Energy dissipated by damping, vibration isolation and Transmissibility. Vibration measuring instruments.

Module 3

Two degree freedom systems: - Principal modes of vibration, Rectilinear and angular modes, systems with damping, vibration absorbers, centrifugal pendulum damper, dry friction damper, untuned viscous damper.

Multi-degree of freedom system: - Free vibrations, equations of motion, Influence coefficients method, lumped mass and distributed mass systems, Stodola method, Dunkerly's method, Holzer's method, Matrix iteration method.

Torsional Vibrations: - Torsionally equivalent shaft, torsional vibration of two-rotor, three-rotor, and geared systems.

Module 4

Critical speeds of shafts: - Critical speed of a light shaft having a single disc without damping. Critical speeds of a light cantilever shaft with a large heavy disc at its end.

Transient vibration: - Laplace transformation, response to an impulsive input, response to a step input, response to a pulse input, phase plane method, shock spectrum.

Non-linear vibrations: - Phase plane, undamped free vibration with non-linear spring forces, hard spring, soft spring, Perturbation method, Forced vibration with nonlinear forces, Duffings equation, self excited vibrations.

Module 5

Noise control: - Sound propagation, decibels, acceptance noise levels, Air columns, Doppler effect, acousticl measurements, microphones and loud speakers, Recording and reproduction of sound, fourier's theorem and musical scale, Acoustics of buildings, Acoustic impedence filters and human ear.

References

1. Theory of Machines - Thomas Bevan
2. Theory of Machines - P.L. Ballaney
3. Mechanical Vibrations, V edition - G.K. Groover
4. Theory of Vibrations with applications, III Edn - W.T. Thomson
5. Mechanical Vibrations - S. Graham Kelly, Schaum's outlines
6. Fundamentals of Vibrations - Leonard Meirovitch, Mac Graw Hill
7. A text book of sound - L.P. Sharma & H.C. Saxena
8. Engineering Noise Control - D.A. Bies & C.H. Hausen.
9. Noise & Vibration Control - Leo N. Beraneck

MACHINE DESIGN AND DRAWING - I

M 705 **2+0+2**

Module 1

Definitions - Design principles – common engineering materials – selection and their properties – general steps in design – design criteria – types of failures - types of cyclic loading.

Stresses in Machine parts – tension, compression and shear –elastic constants-working stress-factor of safety-bending and torsion-combined stresses-stress concentration-fatigue-endurance limit-fatigue diagram-fatigue factors-theories of failure-Goodman and Soderberg lines

Detachable joints-socket and spigot cotter joint, knuckle joint – pins, keys, splines

-set screws, threaded fasteners and power screws – Shaft coupling – sleeve

coupling – split muff coupling – flange coupling – protected type flange coupling

– thick and thin cylinders

Riveted joints: Lap joint – Butt joint – failures of riveted joint – strength of riveted joint – efficiency of riveted joint – design of longitudinal butt joint for boiler – design of circumferential lap joint for boiler – joints of uniform strength – Lozange joint – eccentrically loaded riveted joint.

Module 2

Springs – Classification and uses of springs – design of helical springs – effect of end turns – energy absorbed – deflection – design for fluctuating loads – vibration in springs – buckling of spring materials

Shafts – Torsion and bending of shafts – hollow shafts – design of shafts for strength an deflection – effect of keyways – transverse vibration and critical speed of shafts

Design of IC engine parts – connecting rod – piston – flywheel –

Welded joints: Lap joint – Butt joint – weld symbols parallel and transverse fillet welds – strength of welded joints – axially loaded welded joints – eccentrically loaded welded joints.

References

1. Mechanical Engg. Design – Joseph Shigley
2. Machine Design – Mubeen
3. Machine Design – Black
4. Machine Design – R. K. Jain
5. Machine Design an integral approach – Norton, Pearson
6. Machine Design data hand book – Lingayah Vol I.
7. Elements of Machine Design – Pandya & Shah

Note

For the University Examination 100% choice may be given. i.e. two questions from each module with full choice.

OPTIMIZATION TECHNIQUES (ELECTIVE - I)

CMELRTA 706-1 **3+1+0**

Module 1: Classical optimization techniques

Single variable optimization – Multivariable optimization with no constraints – Hessian matrix – Multivariable saddle point – Optimization with equality constraints – Lagrange multiplier method - Multivariable optimization with inequality constraints – Kuhn-Tucker conditions.

Module 2: **One-dimensional unconstrained minimization**

Elimination methods – unrestricted search method – Fibonacci method – Interpolation methods – Quadratic interpolation and cubic interpolation methods.

Module 3: **Unconstrained minimization**

Gradient of a function – Steepest descent method – Newton's method – Powells method – Hooke and Jeeve's method.

Module 4: **Integer – Linear programming problem**

Gomory's cutting plane method – Gomory's method for all integer programming problems, mixed integer programming problems.

Module 5: Network Techniques

Shortest path model – Dijkstra`s Algorithm – Floyd`s Algorithm – minimum spanning tree problem – PRIM algorithm – Maximal Flow Problem algorithm.

References

1. Optimization theory and application - S.S. Rao, New Age International P. Ltd.
2. Optimization Concepts and applications in Engineering - A.D.Belegundu, T.R. Chandrupatla, Pearson Education Asia.
3. Principles of Operations Researc for Management - F. S. Budnick, D. McLeavey, R. Mojena, Richard D. Irwin, INC.
4. Operation Research an introduction - H. A. Taha, Eastern Economy Edition.
5. Operations Research - R. Panneerselvam, PHI

PLANT ENGINEERING AND MAINTENANCE (ELECTIVE-I)

M 706-2 **3+1+0**

Module 1

Wear and Lubrication: -wear-classification-theories of wear-analytical treatment of wear- stages of wear-effect of moisture, gas and liquid on wear-effects of temperature-corrosive wear- fretting-fatigue-calculation of working life-design considerations.

Module 2

Lubricants: -solid, fluid and semifluid-synthetic lubricant-general properties and uses-tests and classification-aniline point-cloud, pour and flash point-carbon residue-flash and fire points- sulphur content-lubricant additives-lubricant systems-lubrication equipments and components.

Module 3

Maintenance: -Breakdown and preventive maintenance-deterioration and failure analysis- planning, scheduling, and controlling of maintenance work-organisation for maintenance.

Replacement: - causes of deterioration and obsolescence-sudden and gradual obsolescence and deterioration-economic analysis-MAPI method. Evolution of maintenance management-SWOT analysis-subjective methods of evaluation-objective criteria of evaluation.

Module 4

Reliability: -concept and definition-chance of failure-wear and failure application of stochastic model for reliability studies-reliability of series, parallel and stand by systems-estimation of parameters of failure distribution-maintainability and availability-problems.

Module 5

Non destructive testing and diagnostic instruments: - inventory control of spare parts-simple problems.

Safety management: - accident prevention program-designing of safe operation-fire protection –legal provisions for safety in industry.

References

1. Standard Handbook of Plant Engineering - Robert C.Rosder
2. Reliability&Maintainability Management - Balbir S.Shillon
3. Industrial Maintainence Management - Sushilkumar, Srivasthava
4. Handbook of Tribology - Bharat Bhooshan, B.K.Guptha
5. Inspection, Quality control and Reliability - S.C.Sharma
6. Maintenance and Spare parts management - P.Gopalakrishnan, A.K.Banergy.

WELDING TECHNOLOGY (ELECTIVE - I)

M 706-3 **3+1+0**

Module 1

Introduction: - Welding as a fabrication process- advantages and limitations – principal types of welding process and their characteristics.

Soldering & Brazing: -Soldering – principles of soldering, Tin-Lead binary diagram- different types of solders – need of fluxes for soldering and different fluxes used – method of soldering – silver soldering and aluminium soldering – advantages and limitations.

Brazing: - Principle of Brazing – brazing alloys & fluxes- methods of brazing – aluminium brazing – advantages & limitations.

Pressure Welding Process: - Forge welding- spot welding – seam welding – projection welding- butt welding – flash butt welding – welding of tubes & percussion welding.

Module 2

Fusion Welding: Oxy-acetylene welding – chemistry of oxy-acetylene welding flame – type of flames & adjustments – welding set up & arrangements – preparation & storing of acetylene as well as oxygen gases- rightward & leftward welding techniques – filler metals & fluxes used for gas welding – weld movements – welding of: cast iron, stainless steel, aluminium, copper, nickel & magnesium- safety rules in oxy-acetylene welding.

Module 3

Electric arc welding: Electric properties of the arc – arc column theories: ion theory & electron theory- heat distribution in an electric arc – arc welding power

sources – their specific characteristics advantages & limitations – arrangements for straight & reverse polarities – striking of an arc – types of weld movements – welding positions – welding symbols – Electrodes – needs & types of electrodes covering – classification of arc welding electrodes.

Arc welding Processes: Carbon arc welding – single & twin carbon arcs – flux shielded metal arc welding – submerged arc welding – TIG & MIG welding and atomic hydrogen welding.

Module 4

Special or Unique welding processes: Various welding processes – their specific applications – neat sketches- advantages & limitations: Electroslag welding – Plasma arc welding – Ultrasonic welding – Electron beam welding – Laser beam welding – friction welding – explosive welding & cold welding processes.

Module 5

Basic metallurgy of welding: Three prominent zones: weld metal zone – heat affected zone & the unaffected zone.
Welding Stresses: causes of development of residual stresses – methods of relieving or controlling of residual stresses in weldments.

Defects: commonly found defects in welded joints.
Inspection & testing of weldments: - Needs of inspection & testing of weldments – the various testing methods – destructive tests such as tensile, bend, impact, neck break & hardness tests – Non destructive tests such as Magnetic particle, Ultrasonic, Dye-penetratant, radiographic & eddy current methods.

References

1. Welding Engineering -Rossi
2. Welding & welding Technology -Little.
3. Metallurgy of welding -Bruckner
4. The Electric Welder -Tse Golsky
5. Welding Engineer's Hand Book Vol 1,2 & 3 (ASME)
6. Welding for Engineers -Udin & Funk
7. A text book of Welding Technology -O.P Khanna
8. Welding Engineering -R.L Agarwal
9. Welding engineering & Technology -R. S. Parmer
10. Welding (10^{th} Edition) -A. C. Davis, Cambridge University Press.

FOUNDRY TECHNOLOGY (ELECTIVE - I)

M 706-4 **3+1+0**

Module 1

Patterns: Different types of patterns – colour codes of patterns.

Moulding sands: Natural and synthetic sand- ingredients of moulding sands- special sand additives sand mixing- general properties of moulding sand – testing of moulding sand - effect of ingredients and Additives on properties of moulding sand- reusability of moulding sands- sand conditioning.

Core and core making: Purpose of cores - core prints – types of cores – core sand ingredients – requirements of core sand- core sand mixing – binding materials – core boxes, core making, baking, coating, reinforcing and venting.

Module 2

Gating and risering: Mechanism of solidification – nucleation and growth – rate of solidification – progressive and directional solidification.

Gates and gating system – functions and types of gates – design of gating system – gating ratios for ferrous and nonferrous castings – risering- functions and requirements of riser – types of risers - theoretical considerations – Chvorinov s rule – riser shape and directional solidification – use of chills, insulators and exothermic compounds

Module 3

Ferrous foundry metallurgy: Gray cast iron – composition – effect of composition in properties – types of graphite in gray cast iron – foundry characteristics of grey cast iron – effect of inoculation and inoculants – low alloy and high alloy cast iron –malleable iron – white heart and black heart malleable iron – malleablisation – S.G. iron – compositon and properties

Module 4

Non-ferrous foundry metallurgy: Foundry characteristics of copper and aluminium base alloys – degassing and melt treatment.

Melting and pouring: Types of furnaces used for C.I., steel and non-ferrous metals – details and charge calculation in cupola charging

Module 5

Cleaning and inspection: Knock out and fettling – destructive and non-destructive testing- salvaging.

Mechanisation in foundry: Elementary ideas of mechanisation in sand conditioning and supply, moulding, core making, knock out and fettling.

References

1. Principles of Metal Casting - Hine and Rosenthal
2. Foundry Technology - P.R.Beeley
3. Manufacturing Science - Amitabha Ghosh and Ashok Kumar Mallick
4. Manufacturing Engineering and Technology - Kalapakjian and Schmid

ADVANCED OPERATIONS RESEARCH (ELECTIVE - I)

M 706-5 **3-1-0**

Goals: The course is designed to develop an understanding of operation research with particular attention to linear programming, dynamic programming, and integer programming.

Module 1

- **Linear Programming**
    1. Problem Formulation
    2. Graphical Solution
    3. Simplex Method
    4. Revised Simplex Method
    5. Duality Theory
    6. Sensitivity Analysis

Module 2

- **Transportation Model**
    1. North-west corner method
    2. Least cost method
    3. VAM
    4. Test of optimality

Module 3

- **Integer Programming**
    1. Introduction, basic concepts and simple problems
    2. Gomory's all integral cutting plane method

- **Goal Programming**
    1. Application of goal programming
    2. Introduction basic concepts and simple problems

Module 4

- **Dynamic Programming**
    1. Shortest path models
    2. Characteristic of Dynamic Programming
    3. Discrete Dynamic Programming models

Module 5

- **Simulation**
    1. Basic Concepts

1.1 Binomial distribution

1.2 Poisson distribution
1.3 Normal distribution
2. Monti-cralo simulation
3. Generation of random numbers
4. Simulation software

Course Outcomes

1. Students will have a working knowledge of operation research techniques such as linear programming, Integer Programming, Goal Programming and Dynamic Programming.
2. Students will have the ability to analyze and perform sensitivity analysis on different optimum solutions generated.
3. Students will have the ability to tackle real life optimization problems.

References

1. Hamda & Taha, Operations Research - 7th edn; Pearson
2. Ravindran and Philips Operations Research – Principles and Practice.
3. Ronald L.Rardin, Optimisation in Operation Research, Pearson Education
4. Verma A.P., Operation Research, S.K.Katharia & Sons

MARKETING AND SALES MANAGEMENT (ELECTIVE - I)

M 706-6 **3+1+0**

Module 1

Marketing: Definition- Marketing concepts- Market segmentation- Market demand- Product- Value and satisfaction- Exchange and transactions- Marketing channels- Competition- Marketing environment- Marketing mix.

Marketing Management: Functions-Sales forecasting-Pricing-Distribution-Advertising- Sales promotion- Marketing research.

Module 2

Strategic Planning: Strategic business unit (SBU)- Business strategic planning-SWOT analysis. Marketing decision support system.

Module 3

Product life cycle: Marketing strategies in the different stages of product life cycle.

New product development: Idea generation- Concept development and testing-conjoint analysis.

Introduction to Relationship marketing, International marketing and on line marketing.

Module 4

Consumer behaviour: Major factors affecting consumer buying behaviour- Consumer decision making process.

Organisational buying behaviour: Buying situations- the buying center- Purchasing process.

Module 5

Sales management: Evolution of Sales management- Objectives of Sales management- Personal selling situations- Theories of selling- Basic selling styles- Recruitment, selection and training of sales personnel-Sales territory-Sales quotas.

References

1. Marketing Management - Philip Khotler
2. Sales Management - Richard, Edward & Norman
3. Industrial Engg & Management - O.P.Khanna
4. Industrial Organisation & Management - Banga & Sarma
5. Organisational Behaviour - Fred Luthans
6. Consumer Behaviour - Schifman & Kanuk
7. Basic marketing - Gundiff
8. Marketing Management for small units - Jain
9. Sales Engg - Lester
10. Salesmanship concept - Thomson

COMPUTATIONAL FLUID DYNAMICS (ELECTIVE - I)

M 706 -7 **3+1+0**

Module 1

Basic concepts: -conservation principles-mass, momentum energy-conservation of scalar quantities-dimensionless form of equations-simple mathematical models for incompressible, inviscid, potential and creeping flows-approximations of hyperbolic, parabolic, elliptic, and mixed flows- introduction to numerical methods, advantages and limitations-components of numerical solution methods and properties.

Module 2

Finite difference methods: - concept-approximation of first derivative, second derivative and mixed derivative-boundary conditions, errors, spectral methods,

examples-finite volume method, approximation of surface and volume integrals, boundary conditions-examples.

Module 3

Solutions of Linear Equations: - direct methods-Gauss elimination method-LV decomposition- tridiagonal system-cyclic reduction-iterative methods-conyergence-conjugate gradient- multigrid methods-non linear equations-deferred correction approaches, methods for unsteady problems, two level Runge Kutta predictor corrector methods-explicit, implicit methods.

Module 4

Solutions of Navier Stokes equations: -choice of variable arrangement on grid-calculation of pressure-other methods-solution methods for Navier Stokes equations.

Module 5

Turbulent flows: - direct numerical solution-large eddy simulation, RANS models, Reynolds stress models- compressible flows (introduction only)-pressure correction models-simple examples.

References

1. Computational methods for Fluid Dynamics -Joel H.Ferziger & Miloven Peric. (Springer Werlag Publishers)
2. Computational Fluid Dynamics (The basics with applications) -John D.Anderson (Mc Graw Hill Pub.)
3. Numerical methods for Scientific& Engineering Computations - M.K.Jain & R.K.Iyengar (WileyEastern)
4. Introduction to Numerical Analysis - F.B.Hilderbrand. (Tata Mc GrawHill)

MECHANICAL ENGINEERING LABORTAORY

M 707 **0+0+4**

Tests on reciprocating air compressor
Tests on blowers and rotary compressors
Vibration of springs – free and forced vibrations.

Whirling of shafts.
Balancing of reciprocating and revolving masses – balancing machines.
Tests on universal governor apparatus.

Tests on gyroscope.
Friction in hydrodynamic bearings – bearing testing machines.
Metallurgical analysis of specimens using metallurgical microscope.
Testing of foundry sands for strength, moisture content, permeability etc.
Determination of minimum fluidizing velocity in a conventional fluidized bed.

HEAT TRANSFER LABORTAORY

M 708 **0+0+4**

Tests on refrigeration equipment.
Tests on air conditioning units.

Determination of thermal conductivity of conducting and insulating materials.
Determination of emissivity of surfaces
Heat flow through lagged pipes.
Heat flow through composite walls.
Determination of overall heat transfer co-efficient of a heat exchanger.
Free and forced convection.

EIGHTH SEMESTER

PRODUCTION ENGINEERING

M 801 **2+1+ 0**

Module 1

Theory of metal cutting: Historical back ground –Classification of manufacturing process – Deformation of metals (review only) – Performance & process parameters - Oblique & orthogonal cutting – Mechanism of chip formation, types, chip curl, chip control – Tool geometry: American, British, DIN, ISO systems – Mechanism of orthogonal cutting: Thin zone model, Merchant's analysis, Oxley thin shear zone analysis – Thick zone models, Palmer & Oxley analysis – shear angle relationship, Lee & Shaffer`s; relation ship etc. – Friction process in metal cutting: nature of sliding friction, effect of increasing normal load on apparent to real area of contact , columb`s law, yield stress at asperities, adhesion theory, ploughing, sublayer flow – Effect of rake angle,cutting angle, nose radius etc. on cutting force and surface finish – Empirical determination of force component.

Module 2

Thermal aspects of machining: Source of heat; temperature distribution in chip, shear plane & work piece; effect of speed, feed & depth of cut – Tool materials: carbon steel, HSS, coated HSS, ceramics, diamond etc.- Cutting fluids: effect of specific heat, etc on selection of liquids; effectiveness at tool chip interface; classification of fluids – Tool wear: flank & crater [KT] wear – Tool wear mechanisms: adhesion, abrasion, diffusion & fatigue; Taylor's equation, application at shop floor; speed, tool material & micro structure on tool life; allowable wear land [VB] ; rapid, steady & catatospheric wear on rough & finishing operations – Economics of machining – Machineability index.

Module 3

Power metallurgy: Preparation metal powers – Power characteristics: properties of fine power, size, size distribution, shape, compressibility, purity etc.- Mixing – Compaction techniques – Mechanism of sintering of single & multi phase materials - Sintering atmosphere – Finishing operations: heat treatment, surface treatment, impregnation treatment etc. – Impregnated bearings – Sintered oil-retaining bearing – Economics of p/m.

Advanced materials: Super alloys - Titanium & titanium alloys – shape memory alloys –smart materials – microstructure, properties, applications.

Module 4

Polymers*:* Polymerization – Structural features: Linear & net work molecular structure – Molecular wt, degree of polymerization, branching, cross linking – co polymers & ter polymers – Molecular architecture – effect of crystallinity – Glass transition temp: - Thrmo polymers – Thermoset polymers – Additives – Polymer matrix composites: properties & applications. - *Elastamers*: Kinked structure - Mechanical, physical & chemical properties – Vulcanization of rubber – conductive polymers, applications. – *Ceramics*: Structure – Mechanical, physical

properties & applications. – *Glasses*: Types, glass ceramics – Types, properties and application of MMC and CMC – Honey comb structure.

Module 5

Advanced production methods: Rapid prototyping: background & definitions – Process methods: Stereolithography, selective laser sintering, fused deposition modeling, laminated object manufacturing, laser engineered net shaping, 3D welding – Information processing – Indirect fabrication of metals & ceramics. – *Non traditional machining*: EDM, ECM, USM – principle, types, process parameters, control, MRR, surface finish, application etc. – Electro chemical grinding, lapping, honing; process principle & Ra only, applications – EBM, LBM, IBM, AJM, Abrasive water jet machining, LIGA process.

References

1. Armarego & Brown, The Machining of Metals, Prentice - Hall
2. Beaman, Barlow & Bourell, Solid Free Foam Fabrication: A new direction in mafg., Kluwer Academic Publishers
3. Brophy, Rose & Wulf, The Structure & Properties of Metals Vol.2, Wiley Eastern
4. Dixon & Clayton, Powder Metallurgy for Engineers, Machinery publishing co. London
5. HMT, Production Technology, Tata McGraw Hill
6. Kalpakjian, Manufacturing Engineering & Technology, Addison – Wesley, 4nd edn.
7. Lal G.K., Introduction to Machining Science, New Age publishers
8. Metcut research, Machinablity Data Center Vol.1 & 2, Metcut research associates, Cincinnati
9. Paul. H. Black, Theory of Metal Cutting, McGraw Hill

AUTOMOBILE ENGINEERING

M 802 **3+1+0**

Module 1

Engines: Types of engines in automobiles-classifications-engine components-working of various systems-CNGengines-R&D works-present and future vehicles-frame, body and engine construction-structure and mechanism forming components- carburetors, diesel fuel pumps, injector, single point and multi point fuel injection-combustion chambers-lubricating oil pumps-cooling systems-Vehicle performance-resistance to the motion of vehicle-air, rolling, and radiant resistance-power requirement-acceleration and gradeability-selection of gear ratios.

Module 2

Transmission: prime movers-clutch-principle-friction-helical spring and conical spring clutches –centrifugal clutches and fluid couplings-Gear box-principle and necessity of manual gear box- constant mesh, sliding mesh and synchromesh gear boxes-epicyclic gearbox-overdrives-hydraulic torque converters-semi and automatic transmission-Final drive-front wheel, rear wheel and four wheel drives-transfer case-Hotchkiss and torque tube drives-universal joints-constant velocity universal joint-differential-non-slip differential-rear axles-types of rear axles.

Module 3

Steering and Suspension: Different steering mechanisms-steering gear boxes-power steering –types-suspension systems-front axle, rigid axle and independent suspensions-anti-roll bar-coil spring and leaf spring-torsion bar-Macpherson strut-sliding pillar-wish bone-trailing arm suspensions-front axle types-front wheel geometry-castor, camber, king pin inclination, toe-in toe-out. Shock absorbers-hydraulic and gas charged shock absorbers-air suspensions.

Module 4

Chassis and Body: Types of chassis and body constructions-crumble zones, air bags and impact beams-automotive air conditioning-braking mechanism and convectional brakes- booster, hydraulic and power brakes, components and attachments-mechanical, hydraulic and pneumatic brakes-anti-lock braking systems-Wheels and Tyres:tube-less tyres-ply ratings- radial tyres-hybrid vehicles-vintage cars-racing cars-automated roads-coach works-materials- safety provisions- motor vehicle act.

Module 5

Electrical systems Battery, charging and ignition systems-electronic ignition-dynamos and alternators-voltage regulators-light and horn relays-circuit diagrams-starting motor-bendix and follow through drives-power windows-electronic engine control unit for fuel injection- automotive lighting, accessories and dashboard instruments-Preventive and breakdown maintenance-engine testing, servicing-overhaul- engine tuning- wheel balancing-trouble shooting-garage tools and equipments-noise, vibration, and performance tests.

References

1. Automobile Engineering (Vol. 1 & 2) - K.M.Guptha
2. Automotive Mechanics - Joseph Heitner

3. Automobile Engineering - Harbans Singh Reyd
4. Automotive Mechanics - William H. Course

PRODUCTION PLANNING AND CONTROL

M 803 **2+1+0**

Module 1

Introduction to PPC: need for PPC, effect, advantages, functions and problems of PPC.

Forecasting: methods of sales forecasting-forecasting for new products-forecasting for established products-time series analysis for sale forecasting – long term forecasting – methods of estimating Sales trend- problems- correlation analysis.

Module 2

Production planning: objectives-characteristics-process planning. Capacity planning- factors affecting-Master production scheduling-material requirement planning – BOM and product structure.

Production control: objectives- production control systems- principle and procedure of production Control.
Routing: objectives- procedure – route sheets.

Module 3

Sequencing assumptions: solution of sequencing problems-processing n jobs through two machines
Processing n jobs through three machines – processing n jobs through m machines – processing two
Jobs through m machines-problems

Module 4

Materials management: Components of integrated material management Purchasing management- stores management. Supply chain management – ERP-Role of I.T.

Module 5

Loading and scheduling: aim- reasons for scheduling- master scheduling or aggregate scheduling
Estimating shop loads- short term scheduling – mathematical loading and scheduling- problems-
Scheduling through PERT / CPM problems.

Despatching- duties- procedure- rules.
Follow up and reporting- types-report preparation and presentation.

References

1. Modern Production Management - E.S.Buffa
2. Principles of Production Management - J.Apple
3. Production management principles - Mcycss
4. Production Planning and Control - K.C.jani& L.N.Aggarwal
5. Manufacturing Planning &Control - Volfman, Berry, Whybark systems
6. Production and operations management - R.Paneerselvam
7. Modeling the supply chain - Jeremy F Shapiro

MACHINE DESIGN AND DRAWING - II

M 804 **2+0+2**

Module 1

Gears: Types of gears –spur gear, helical gear, bevel gear, worm and worm wheel- strength of gear teeth – gear forces and their effects – formative number of teeth – lead – lead angle-basic geometry and nomenclature of meshed spur gear set-dynamic load – endurance load-wear loads – AGMA standards – Lewis equation for strength design and Lewis form factor – design for wear – design of gears such as spur gear, helical gear, bevel gear, worm and worm wheel.

Module 2

Bearings: Bearing materials – introduction to lubrication – minimum film thickness – hydrodynamic theory of lubrication – viscosity of oil – oil seals – selection of lubricants – viscosity index – measurement of viscosity – effect of temperature on viscosity – clearance ratio – summer feld number – specifications and selection of bearing – anti friction bearing – bearing life – rating life – dynamic load capacity – equivalent dynamic load – design of journal bearing – design of rolling contact bearing such as ball and roller bearing.

Pumps: Design of centrifugal pump (Simple problems)

References

1. Mechanical Engineering Design – Joseph Shigley
2. Machine Design – Mubeen
3. Machine Design – Black
4. Principles of Lubrication – Cameron A.
5. Mechanical Seals – Mayer E.
6. Design of Machine Elements – Bhandari V. B.
7. Machine Design – Pandya and Shah

Note

Question Paper pattern same as Machine Design - I

ADVANCED MATHEMATICS (ELECTIVE - II)

CMELRTM 805-1 **3+1+0**

Module 1 Green's Function

Heavisides, unit step function – Derivative of unit step function – Dirac delta function – properties of delta function – Derivatives of delta function – testing functions – symbolic function – symbolic derivatives – inverse of differential operator – Green's function – initial value problems – boundary value problems – simple cases only

Module 2 Integral Equations

Definition of Volterra and Fredholm Integral equations – conversion of a linear differential equation into an integral equation – conversion of boundary value problem into an integral equation using Green's function – solution of Fredhlom integral equation with separable Kernels – Integral equations of convolution type – Neumann series solution.

Module 3 Gamma, Beta functions

Gamma function, Beta function – Relation between them – their transformations – use of them in the evaluation certain integrals – Dirichlet's integral – Liouville's extension of Dirichlet's theorem – Elliptic integral – Error function.

Module 4 Power Series solution of differential equation

The power series method – Legendre's Equation – Legendre's polynomial – Rodrigues formula – generating function – Bessel's equation – Bessel's function of the first kind – Orthogonality of Legendre's Polynomials and Bessel's functions.

Module 5 Numerical solution of partial differential equations.

Classification of second order equations- Finite difference approximations to partial derivatives – solution of Laplace and Poisson's equations by finite difference method – solution of one dimensional heat equation by Crank – Nicolson method – solution one dimensional wave equation.

References

1. Linear Integral Equation - Ram P.Kanwal, Academic Press, New York
2. A Course on Integral Equations - Allen C.Pipkin, Springer – Verlag
3. Advanced Engg. Mathematics - H.K.Dass, S.Chand
4. Advanced Engg. Mathematics - Michael D.Greenberge, Pearson Edn. Asia
5. Numerical methods in Engg. &Science - B.S.Grewal, Khanna Publishers
6. Generalized functions - R.F. Hoskins, John Wiley and Sons.
7. Principles and Techniques of Applied Mathematics - Bernard Friedman, John Wiley and sons
8. Principles of Applied Mathematics - James P.Keener, Addison Wesley.
9. Numerical methods - P.Kandasamy, K.Thilagavathy, K.Gunavathy, Chand & co

EXPERT SYSTEMS IN MANUFACTURING (ELECTIVE - II)

M 805-2 ***3+1+0***

Module 1

Artificial Intelligence - expert / knowledge based systems - definition - expert system architecture: software components, knowledge base, inference engine, inference sub systems.

Module 2

Hard ware requirements - knowledge acquisition, knowledge base, knowledge representation - semantic netwoks, objects, nods; links, attributes, values - semantic net work structures: nodes, object, links, attributes, values.

Module 3

Knowledge representation: rule based system - heuristic rules - frame based knowledge representation - inference engine components - inferences strategies; modus ponens, backward & forward chaining, monotonic & non monotonic reasoning, search strategies - expert system building tools: languages, shells.

Module 4

Commercial software for manufacturing applications in CAD, CAPP, MRP - 11, adaptive control of devices, robotics, process control, fault diagnosis, failure analysis etc; linking expert systems to other software such as DBMS, MIS, MDB, process control and office automation.

Module 5

Case studies and programming of typical applications in process planning, tool selection, Grinding wheel selection, part classification, inventory control, facilities planning etc.

References

1. Peter Jackson - Introduction to Expert systems, 3/e, by; Addison Wesley Longman, 1999.
2. Prentice - hall hand book of expert systems

AEROSPACE ENGINEERING (ELECTIVE - II)

M 805-3 **3+1+0**

Module 1

The atmosphere: Characteristics of Troposphere, Stratosphere, Mesosphere and Ionosphere - International Standard Atmosphere – Pressure, Temperature and Density variations in the International Standard Atmosphere – Review of basic fluid dynamics – continuity, momentum and energy for incompressible and compressible flows – static, dynamic and stagnation pressures – phenomena in supersonic flows

Module 2

Application of dimensional analysis to 2D viscous flow over bodies – Reynolds number – Mach number similarity – Aerofoil characteristics – Pressure distribution – Centre of Pressure and Aerodynamic Center – Horse shoe vortex

Module 3

Momentum and Blade Element Theories – Propeller co-efficients and charts – Aircraft engines – Turbo jet, Turbo fan and Ram Jet engines – Bypass and After Burners

Module 4

Straight and Level Flight – Stalling Speed – Minimum Drag and Minimum Power conditions – Performance Curves – Gliding – Gliding angle and speed of flattest glide – Climbing – Rate of Climb – Service and Absolute Ceilings – Take off and Landing Performance – Length of Runway Required – Circling Flight – Banked Flight – High Lift Devices – Range and Endurance of Air planes.

Module 5

Air speed indicators – Calculation of True Air Speed – Altimeters – Rate of Climb meter – Gyro Compass – Principles of Wind Tunnel Testing – Open and Closed type Wind Tunnels – Pressure and Velocity Measurements – Supersonic Wind Tunnels (description only) – Rocket Motors – Solid and Liquid Propellant

Rockets – Calculation of Earth Orbiting and Escape Velocities Ignoring Air Resistance and assuming Circular Orbit.

References

1. Mechanics of Flight - Kermode A. C.
2. Aerodynamics for Engineering Students - Houghton and Brock
3. Airplane Aerodynamic - Dommasch

COMBUSTION (ELECTIVE - II)

M 805-4 **3+1+0**

Module 1

Thermodynamics of reactive mixtures: Bond energy-Heat of formation-Heat of reaction-adiabatic flames temperatures-entropy changes for reacting mixtures-chemical equilibrium – equilibrium criteria –evaluation of equilibrium constant and equilibrium composition –simple numerical solutions.

Module 2

Elements of chemical kinetics: law of mass action-order and molecularity of reaction – rate equation- Arrheniuss law – activation energy – collision theory of reaction rates- Transition state theory-collision theory of reaction rates- Transition state theory –General theory of chain reactions- combustion of carbon monoxide and hydrogen.

Module 3

Ignition and flammability: methods of ignition –self ignition – thermal theory of ignition – limits of flammability –factors affecting flammability limits- flame quenching- flame propagation- flame velocity- measurement of flame velocity – factors affecting flame speed- premixed and diffusion flames – physical structures and comparison – characteristics of laminar and turbulent flames- theory of laminar flame propagation.

Module 4

Flame stabilization: Stability diagrams for open flames- mechanisms of flame stabilization –critical boundary-velocity gradient –stabilization by eddies bluff body stabilization – effects of variables on stability limits.

Module 5

Combustion in solid an liquid propellant: Reactant motors – Classification and types of propellants – desirable properties of grain shapes – burning rates and combustion model of solid propellants- injection of liquid propellants-ignition and ignitors. Miscellaneous topics – droplet combustion – fluidized bed combustion - classification of coal – air pollution.

References

1. Fuels and combustion – Sharma S.P
2. Some fundamentals of combustion – Spalding D.B
3. Fundamentals of combustion – Strehlow . R.A
4. Elementary reaction Kinetics – Lathan J.L
5. Flames – Gaydan and wolfhard.

PROJECT MANAGEMENT (ELECTIVE - II)

M 805-5 **3+1+0**

Module 1

Project feasibility Analysis- Marketing, Technical, and financial feasibilities-report preparation-case studies.

Module 2

Project Management- nature and scope- PERT and CPM techniques, Estimates-time, cost, resources (man, material, tool).

Module 3

Forecasting Methods-Time series analysis-method pf least square, moving average, curvilinear, correlation analysis.

Module 4

Risk Analysis-risk in economic analysis-measuring risk in investment; risk profiles, decision trees, formulation of discounted decision trees, simulation.

Module 5

MS Project: (Software Practice) Creation of task, sequencing of task, assignment of resources, finding critical path, ABC activities (discuss), breaking the activities, colouring techniques, resource balancing, allocating overtime, using different calendars (Like 8 or 12 hours shift, Friday/Sunday holiday, Special public holidays etc), cost estimates, assignment of blank fields, creation of different views on screen.

Reports: Daily reports for completed activity, lagging activities, overall progress review, Management high-level reports, individual Departmental reports.

References

1. Corter, Mastering MS Project 2000, BPB Publishers.
2. Harvey Maylor, Project Management, Pearson Education.
3. PrasannaChandra, Project Management, Tata McGraw Hill.
4. Prasanna Chandra, Projects, Tata McGraw Hill.

PROGRAMMING IN C++ AND VISUAL C++ (ELECTIVE - II)

M805-6 **3+1+0**

Module 1

Introduction to C++ - Object Oriented Approach – I/O instructions – Data types – Type Conversions – Arithmetic Operators – Relational Operators – Loops – Precedence – Conditional Operator – Logical Operators – Structures and its manipulations – Functions – Arrays.

Module 2

Classes and Objects – Specifying the Class – The private and public key words –

Defining Member Functions – Defining Objects – Calling Member Functions –

Constructors – Destructors – Overloaded Constructors – Objects as Arguments –

Returning Objects from Functions – Array of Objects.

Module 3

Operator Overloading – Operator Arguments – Operator Return Values – Postfix Notation – Overloading Binary Operators – Arithmetic Assignment Operators – Data Conversion – Inheritance – Derived Class and Base Class – Specifying The Derived Class – Accessing Base Class Members – The protected Members – Derived Class Constructors – Overriding Member Functions – Scope Resolution

with Overridden Functions – Public and Private Inheritance – Levels of Inheritance – Multiple Inheritance.

Module 4

Pointers – Memory Management – The new and delete Operators – Pointers to Objects – Self Containing Classes – Virtual Functions – Accessing Normal and Virtual Member Functions with Pointers – Pure Virtual Functions – Friend Functions – The 'this' Pointer – Accessing Member Data with 'this'.

Module 5

Introduction to Windows Programming – Basic Windows Program Structure – Different Windows Messages like WM_PAINT, WM_TIMER etc. – Introduction to MFC – MFC Hierarchy - Use of Simple Foundation Classes like CTime, CString, CFile etc. – Exception Handling.

References

1. Object Oriented Programming in Microsoft C++ - Robert Lafore
2. Windows Programming Primer Plus - Jim Conger
3. Programming with ANSI and Turbo C - Kamthane. Pearson

SILICATES - STRUCTURE, PARTICLE ANALYSES AND SPRAY COATING (ELECTIVE - II)

M 805-7 **3+1+0**

Module 1

Silicate Mineralogy in General - Minerals-Definition, Classification-Silicates and non-silicates. Physical properties of minerals-Colour, lusture, transperancy, cleavage, hardness, fracture, form, specific gravity, fusibility & tenacity.

Module 2

Identification of Silicate Minerals - Physical properties, chemical composition and uses of the important silicate minerals-1. Quartz, 2. Feldspars, 3.Pyroxenes, 4.Amphiboles, 5.Micas, 6.Aluminium silicates-andalusite, sillimanite & kyanite, 7.Olivine, 8.Garnets, 9.Chlorites 10. Natrolite, 11.Clay minerals, 12.Asbestose, 13.Talc 14.Tourmaline 15. Staurolite

Module 3

Silicate Mineral Structures - Detailed study of the silicate structures with examples- 1. Nesosilicate, 2.Sorosilicate, 3.Cyclosilicate, 4.Inosilicate, 5.Phyllosilicate & 6. Tectosilicate. Ceramics and silicates.

Module 4

Particle Analyses – Coarse and powder materials- Coarse material-Size distribution- Grain size parameters, coefficient of angularity, specific surface area (actual and theoretical) by sieve analysis. Powder material-Size and area determination by various methods- Blane's methods, air jet sieve, Bacho dust classifier and BET methods.

Module 5

Spray Coating – Basic concepts and general discussion of spray coating. Binders- Ethyl orthosilicate (ETS-40), properties and hydrolysis. Slurries – Binder and different ceramic powders, consistency and determination, drying. Heat source – Plasma arc-transferred and non-transferred arcs, arrangement of spray coating.

References

1. Rutley's elements of mineralogy, H.H.Read, Thomas Murby&Co, London.
2. A text book of mineralogy, E.S. Dana, Wiley Eastern Ltd, New Delhi.
3. Mineralogy, Dier, Howie & Zussman, CBS Publishers, New Delhi.
4. Materials-Their nature, properties and fabrication, Seghal & Linderburg.
5. Material science and manufacturing process, Dhaunedrakumar, S.K.Jain & A.K.Bhargava, Vikas publishing house, New Delhi.
6. Welding and welding technology, Little, Tata McGraw hill publishing Co., New Delhi.
7. Investment casting, H.T. Bidwell, The machinery publishing Co., Ltd, UK.
8. Non-ferrous foundry metallurgy, A.J. Murphy, Pergamon Press Ltd.
9. Welding engineering and technology, R.S. Parman, Khanna publishers, New Delhi.
10. Manufacturing science, Amitabha Ghosh & Asok kumar Mallik, EWP, East West Press Pvt Ltd, New Delhi.

MANAGEMENT INFORMATION SYSTEMS (ELECTIVE - III)

M 806-1 **3+1+0**

Goals

To learn Management Information System (MIS), implementation requirements and process standardisation.

Module 1

Elements of a MIS – Levels of Management – Types of Management information – Technical dimensions of Information – System elements – Characteristics of MIS – Case Study.

Module 2

Building Business Model – Data Base – Report generation and time sharing –

Case study.

Module 3

Communication and distributed Data processing.

Module 4

Managing and controlling the MIS function. Application Development Cycle.

Module 5

Future of MIS – Architecture – reliability – Security – Intelligent Buildings.

Outcomes

Student will learn elements of MIS & steps in implementing MIS. Students will also learn hardware and software selection for MIS.

References

1. Mudric and Rose - Information System and Management.
2. Jerome Kauter - Management Information Systems, Prentice Hall India.
3. R. S. Daver - The Management Process.
4. Mudric, Rose & Callgget - Information System for Modern Management, Prentice Hall India.
5. James Obrein - Management Information Systems

CRYOGENICS (ELECTIVE - III)

M 806-2 **3+1+0**

Module 1

Introduction: Historical development- present areas involving cryogenic engineering. Basic thermodynamics applied to liquefaction and refrigeration process - isothermal, adiabatic and Joule Thomson expansion process - adiabatic demagnetization – efficiency to liquefaction and coefficient of performances irreversibility and losses.

Module 2

Low temperature properties of engineering materials: mechanical properties - thermal properties - electrical and magnetic properties. Properties of cryogenic fluids - materials of constructions for cryogenic applications.

Module 3

Gas liquefaction systems: production of low temperatures - general liquefaction systems - liquefaction systems for neon, hydrogen, nitrogen and helium.

Module 4

Cryogenic refrigeration systems: ideal refrigeration systems- refrigerators using liquids and gases as refrigerants - refrigerators using solids as working media.

Module 5

Cryogenic storage and transfer systems - Cryogenic fluid storage vessels cryogenic fluid transfer systems. Application of cryogenics - cryo pumping - superconductivity and super fluidity - cryogenics in space technology - cryogenics in biology and medicine.

References

1. Cryogenic Systems - Barron R. F
2. Cryogenic Engineering - Scot R. W.
3. Cryogenic Engineering - Bell J.H.

NUCLEAR ENGINEERING (ELECTIVE - III)

M 806-3 **3+1+0**

Module 1

Review of elementary Nuclear Physics: Atomic structure – Nuclear energy and nuclear forces – Nuclear fission

Nuclear reactions and radiations: Principle of radioactive decay – Interaction of α and β rays with matter – Neutron cross section and reactions – The fission process – Chain reaction – Basic principles of controlled fusion.

Module 2

Nuclear reaction principles – Reactor classifications – Critical Size – Basic diffusion theory – Slowing down of neutrons – Neutron flux and power – Four factor formula – Criticality condition – Basic features of reactor control

Module 3

Boiling water reactor: Description of reactor system – Main components – control and safety measures Materials of Reactor: Construction – Fuel – Moderator coolant – Structural materials – Cladding – Radiation damage.

Module 4

Nuclear fuels: Metallurgy of Uranium – General principles of solvent extraction – Reprocessing of irradicated fuel – Separation process – Fuel enrichment.

Module 5

Reaction heat removal: Basic equations of heat transfer as applied to reactor cooling – Reactor heat transfer systems – Heat removal in fast reactors

Radiation Safety: Reactors shielding - Radiation dozes – Standards of radiation protections – Nuclear waste disposal.

References

1. Nuclear Engineering - Glasstone & Sesoske
2. Sources book on Atomic Energy - Glasstone S.

INDUSTRIAL HYDRAULICS (ELECTIVE - III)

M 806-4 **3+1+0**

Module 1

Introduction to hydraulic / pneumatic devices – their application and characteristics – comparison of electric, hydraulic and pneumatic devices.

Module 2

Pumps and motors: Principle of working – range of displacement and pressures-fixed and variable discharge pumps-gear, screw, vane, piston pumps – axial piston pump-swash pump-bent axis pump. Types of hydraulic motors – their characteristics. Accessories-Hydraulic accumulators – intensifiers-filters-heater-cooler.

Module 3

Hydraulic valves: Stop valve- non return valve-relief valve-sequence valve-counter balance valve- pressure reducing valve – flow control valve –irection control valves-their principle of operation- and application-JIC symbols of hydraulic- pneumatic components.

Module 4

Properties of commonly used hydraulic fluids-Typical hydraulic circuits like those used in machine tools –Rivetter- pneumatic Hammer, hydraulic press, and power steering.

Module 5

Fluidics: Introduction of fluidics devices –Principles of working of common fluidics devices like wall attachment devices – proportional amplifiers-turbulent amplifiers- fluidic logic devices – examples of applications of fluidics devices like edge control of steel plate in rolling mills tension control.

References

1. Daniel Bonteille -Fluid Logic and Industrial automation.
2. John Pippenger & Tyler Hicks - Industrial Hydraulics

MACHINE VISION AND APPLICATION (ELECTIVE - III)

M 806-5 **3+1+0**

Module 1

Introduction to machine vision – basics of picture processing, Binary and grey scale images.

Preprocessing concepts – Digital image, Geometrical correction, Grey scale modification, Sharpening and smoothing images.

Module 2

Edge detection and line finding – Spatial differentiation, extraction of line descriptions.

Types of cameras for Machine vision and their principles.

Module 3

Software for measurement and pattern recognition applications with examples – two and three-dimensional measurements. Fourier transformation for pattern recognition applications.

Module 4

Image operation studies, interfacing a robot with a vision system. Basics of hardware for vision system

Module 5

Machine vision applications in engineering – dimension measurement, flaw detection, identification, verification, sorting - co ordinate measuring machines, non-contact type – case studies.

Reference

1. Sonaka M, Hlavac V & Boyle. R. - Image processing, analysis & machine vision

FINITE ELEMENT ANALYSIS (ELECTIVE - III)

M 806-6 **3+1+0**

Goals:

This course is designed to acquaint students with the basic principles of the finite element method, to provide experience with its use in engineering analysis and design, and to provide an opportunity to work with finite element programs used in industry. Computer programming may be involved.

Module 1

Introduction: Structural analysis objectives, static, dynamic and kinematic analysis, skeletal and continuum structures, modeling of infinite d.o.f system into infinite d.o.f system, basic steps in finite element problem formulation, general applicability of the method.

Element types and characteristics: Discretization of the domain, basic element shapes, aspect ratio, shape functions, ganeralised co-ordinates and nodal shape functions, 1D spar and beam elements, 2D rectangular and triangular elements, axisymmetric elements.

Module 2

Assembly of elements and matrices: Concept of element assembly, global and local co-ordinate systems, band width and its effects, banded and skyline assembly, boundary conditions, solution of simultaneous equations, Gaussian elimination and Cholesky decomposition methods, numerical integration, one and 2D applications.

Module 3

High order and isoparametric elements :One dimensional quadratic and cubic elements, use of natural co-ordinate system, area co-ordinate system, continuity and convergence requirements, 2D rectangular and triangular elements.

Module 4

Static analysis: Analysis of trusses and frames, analysis of machine subassemblies, use of commercial software packages, advantages and limitations.

Module 5

Dynamic analysis: Hamilton`s principle, derivation of equations of equilibrium, consistent and lumped mass matrices, derivation of mass matrices for 1D elements, determination of natural frequencies and mode shapes, use of commercial software packages.

Course Outcomes:

1. The students will understand the fundamental principles of finite element theory and applications.
2. The students will be able to built finite element models correctly for various engineering problems and solve the model using existing finite element codes

Text Book

Rao S.S., "The Finite Element Method in Engineering", 2nd edition, Pergamon Press, Oxford, 1989.

References

1. Robert D. Cook, David S. Malkins and Michael E. Plesha, "Concepts and Application of Finite Element Analysis", 3rd edition, John Wiley and Sons, 1989.
2. Chandrupatla T.R. and Belegundu, A. D.," Introduction to Finite Elements in Engineering", Pearrson Pvt. Ltd., 3rd edition 2002.

TOTAL QUALITY MANAGEMENT (ELECTIVE - III)

M 806-7 **3+1+0**

Goal

To give the detailed information on TQM Tools and Techniques for TQM will be known.

Module 1

Introduction – Leadership Concepts – Customer Satisfaction – employee involvement

Module 2

Continuous Process Improvement – Kaizen, Reengineering, PDSA cycle, Juran

Trilogy – Supplier Partnerships – Quality Cost

Module 3

Statistical Process Control (SPC) – Pareto Diagram, Cause – and – Effect diagram, check sheet, histogram.

Benchmarking – Quality Function Development – Failure mode and Effect Analysis (FMEA)

Module 4

Total Quality Control (TQC) – Quality Circles – Poka – Yoke- Just–in-Time (JIT)- KANBAN - '5-5'

Module 5

Implementing procedure of TQM - case studies

Learning Objective

1. Student will clear principles and practices of TQM
2. Student will learn tools and Techniques used in TQM.

3. Students will learn the procedure of implementation of TQM

References

1. Besterfield, Total quality Management, Person Education
2. Besterfield, Quality Control, Prentice - Hall
3. Arora K.C, TQM & 1S0 14000, S K Kataria & Sons
4. Jain & Chitale, Quality assurance and Total quality management, Khanna Publishers.
5. Mitra, Quality control & improvement, Person Education

MECHANICAL MEASUREMENTS LABORTAORY

M 807 **0+0+4**

1. Study of use of laser interferometer for calibration of linear measurements
2. Measurement of temperature:
   Calibration of thermometers and pyrometers
   Preparation and calibration of thermocouple and resistance temperature detectors (TTD & RTD)
3. Measurement of pressure:
   Calibration and use of pressure measuring instruments-Pressure Gauge, Micro manometer, Pressure Transducers, Dead weight pressure gauge calibrator
4. Measurement of speed:
   Calibration and use of tachometers & stroboscope
5. Measurement of linear and angular dimensions:
   Micrometer, Vernier caliper, dial gauge feeler gauge, comparator, interferometer, angle gauge, sine bar, plug gauge and wire gauge
6. Measurement of Flow: Rotameter, watermeter, Anemometer; calibration and use
7. Measurement of surface roughness using subtonic tester
8. Measurement of gear and screw thread profiles- gear tooth calipers, screw thread calipers
9. Measurement of strain and force – calibration of strain gauges and load cells
10. Measurement of vibration – use of vibration pick ups, accelerometer and vibration indicator
11. Acoustic measurements-sound level meter – preparation of noise contours
12. Measurement of PH value
13. Measurement of psychometric properties of air
14. Analysis of Automobile Exhaust gas and Flue gas -Use of instruments like oxygen analyser. Orsat gas analyzer, Gas chromatography.

PROJECT & SEMINAR

M808 **0+0+4**

At the beginning of the seventh semester, students must submit an abstract of their undergraduate project. They must submit a preliminary report at the end of the semester. They will complete the project in the eighth semester**.**

Sessional marks for seminar will be out of 25. Sessional marks for project will be out of 75, in which 35 marks will be based on day to day performance assessed by the guide. Balance 40 marks will be awarded based on the presentation of the project by the students before an evaluation board consists of a minimum of 3 faculty members including the guide.

VIVA -VOCE

M809

A comprehensive Viva-voce examination will be conducted to assess the student's overall knowledge in the specified field of engineering. At the time of viva-voce, certified reports of seminar and project work are to be presented for evaluation