



SCSVMV UNIVERSITY

B.E. MECHANICAL ENGINEERING (PART TIME)

CURRICULA AND SYLLABUS FOR I TO VIII SEMESTERS REGULATIONS 2014

DEPARTMENT OF MECHANICAL ENGINEERING
SRI CHANDRASEKHARENDRA SARASWATHI VISWA MAHAVIDYALAYA
(Declared as Deemed-to-be University under Section 3 of the UGC Act, 1956,
Vide notification No.F.9.9/92-U-3 dated 26th May 1993 of the Govt. of India)
ENATHUR. KANCHIPURAM – 631 561

Department of Mechanical Engineering
B.E-Mechanical Engineering (Part Time)

CURRICULUM

(With effect from 2014-15)

SEMESTER- I

CODE	Subject	No. of Hours				Exam Hours	Maximum marks		
		L	T	P/D	C		I	E	Tot.
PME411	Basic Mathematics for Engineering	3	1	-	3	3	40	60	100
PME412	Engineering mechanics	3	1	-	3	3	40	60	100
PME413	Manufacturing Technology-I	3		-	3	3	40	60	100
PME414	Material Science & Metallurgy	3	-	-	3	3	40	60	100
PME415	Engineering Thermodynamics	3	-	-	3	3	40	60	100
	Total	15	2	-	15		200	300	500

SEMESTER- II

CODE	Subject	No. of Hours				Exam Hours	Maximum marks		
		L	T	P/D	C		I	E	Tot.
PME421	Applied Mathematics for Mechanical Engineers - I	3	1	-	3	3	40	60	100
PME422	Mechanics of Solids	3	1	-	3	3	40	60	100
PME423	Fluid Mechanics & Machinery	3	1	-	3	3	40	60	100
PME424	Manufacturing Technology – II	3	-	-	3	3	40	60	100
PME425	Object Oriented Programming Using C++	3	-	-	3	3	40	60	100
	Total	15	3	-	15		200	300	500

SEMESTER III

CODE	Subject	No. of Hours				Exam Hours	Maximum marks		
		L	T	P/D	C		I	E	Tot.
PME431	Applied Mathematics for Mechanical Engineers - II	3	1	-	3	3	40	60	100
PME432	Kinematics of Machines	3	1	-	4	3	40	60	100
PME433	Applied Thermodynamics	3	-	-	3	3	40	60	100
PME434	Applied Electrical & Electronics Engineering	3	-	-	3	3	40	60	100
PME435	Environmental Science and Engineering	3	-	-	3	3	40	60	100
	Total	15	2	-	16		200	300	500

SEMESTER IV

CODE	Subject	No. of Hours				Exam Hours	Maximum marks		
		L	T	P/D	C		I	E	Tot.
PME441	Applied Mathematics for Mechanical Engineers - III	3	1	-	3	3	40	60	100
PME442	Heat Transfer	3	-	-	3	3	40	60	100
PME443	Dynamics of Machines	3	1	-	4	3	40	60	100
PME444	Metrology And Measurements Systems	3	-	-	3	3	40	60	100
PME445	Thermal Engineering lab	-	-	3	2	3	40	60	100
	Total	12	2	3	15		200	300	500

SEMESTER V

Code	Subject	No. of Hours				Exam Hours	Maximum marks		
		L	T	P/D	C		I	E	Tot.
PME451	Power Plant Engineering	3	-	-	3	3	40	60	100
PME452	Fluid power system	3	-	-	3	3	40	60	100
PME453	Design of Machine Elements	3	1	-	4	3	40	60	100
PME454	Mechatronics	3	-	-	3	3	40	60	100
PME455	Mechatronics Lab	-	-	3	2	3	40	60	100
	Total	12	1	3	15		200	300	500

SEMESTER - VI

Code	Subject	No. of Hours				Exam Hours	Maximum marks		
		L	T	P/D	C		I	E	Tot.
PME461	Computer Aided Design	3	-	-	3	3	40	60	100
PME462	Computer Integrated Manufacturing	3	-	-	3	3	40	60	100
PME463	Design of Transmission Systems	3	1	-	4	3	40	60	100
PME464	Finite Element Analysis	3	-	-	3	3	40	60	100
PME465	CAD/CAM Lab	-	-	3	2	3	40	60	100
	Total	12	1	3	15		200	300	500

SEMESTER - VII

Code	Subject	No. of Hours				Exam Hours	Maximum marks		
		L	T	P/D	C		I	E	Tot.
PME471	Principles of Industrial Management	3	-	-	3	3	40	60	100
PME472	Total Quality Management	3	-	-	3	3	40	60	100
PME473 (A to L)	Elective – I	3	-	-	3	3	40	60	100
PME474 (A to L)	Elective – II	3	-	-	3	3	40	60	100
PME475	Project Work	-	-	9	6	3	40	60	100
	Total	12	-	9	18		200	300	500

L : Lecture Periods;

I : Internal Assessment;

T : Tutorial Periods;

E : External Assessment;

P/D : Practical / Drawing Periods;

Tot. : Total Marks

C : Credits

Total credits 15+15+16+15+15+15+15+18 =109

LIST OF ELECTIVE SUBJECTS

VII SEMESTER ELECTIVE – I

Code	Subject
PME473A	Energy Conservations in Industries
PME473B	Plant layout and Material handling
PME473C	Casting & Welding processes
PME473D	Design of Jigs & Fixtures
PME473E	Turbo Machines
PME473F	Total Productive Maintenance
PME473G	Gas Dynamics & Jet Propulsions
PME473H	Vibration & Noise Control
PME473I	Refrigeration and Air-Conditioning
PME473J	Computational Fluid Dynamics
PME473K	Nano Technology
PME473L	Work Study and Cost Estimation

VIII SEMESTER ELECTIVE – II

PME474A	Design of Heat transfer Equipments
PME474B	Cryogenic Engineering
PME474C	Internal Combustion Engines
PME474D	Product Design & Development
PME474E	Robotic Technology
PME474F	Tribology
PME474G	Nontraditional machining Processes
PME474H	Theory of Metal Forming
PME474I	Production of Automotive Components
PME474J	Entrepreneurship Development
PME474K	Non Destructive Evaluation
PME474L	Additive Manufacturing Technology

point functions - Integration of vectors - Line integral - Surface integral - Green's theorem in the plane (without proof) - Stoke's theorem (without proof) - Volume integral - Gauss divergence theorem (without proof) - Irrotational fields

TEXT BOOK:

Grewal B.S, Higher Engineering Mathematics, 41st Edition, Khanna Publishers, New Delhi, 2011.

REFERENCES

- 1 Alan Jeffrey, Advanced Engineering Mathematics, Academic Press
- 2 Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons
- 3 Gerald C.F and Wheatley P.O, Applied Numerical Analysis, Addison-Wesley Publishing Company.

UNIT- I**9**

BASICS AND STATICS OF PARTICLES - Introduction – Units and Dimensions – Laws of Mechanics – Lamé's theorem, Parallelogram and triangular Law of forces – Vectors – Vectorial representation of forces and moments – Vector operations: additions, subtraction, dot product, cross product – Coplanar Forces – Resolution and Composition of forces – Equilibrium of a particle – Forces in space – Equilibrium of a particle in space – Equivalent systems of forces – Principle of transmissibility – Single equivalent force.

UNIT -II**9**

EQUILIBRIUM OF RIGID BODIES Free body diagram – Types of supports and their reactions – requirements of stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scalar components of a moment – Varignon's theorem – Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions – Examples

UNIT -III**9**

PROPERTIES OF SURFACES AND SOLIDS - Determination of Areas and Volumes – First moment of area and the Centroid of sections – Rectangle, circle, triangle from integration – T section, I section, - Angle section, Hollow section by using standard formula – second and product moments of plane area – Rectangle, triangle, circle from integration – T section, I section, Angle section, Hollow section by using standard formula – Parallel axis theorem and perpendicular axis theorem – Polar moment of inertia – Principal moments of inertia of plane areas – Principal axes of inertia – Mass moment of inertia – Derivation of mass moment of inertia for rectangular section, prism, sphere from first principle – Relation to area moments of inertia.

UNIT -IV**9**

DYNAMICS OF PARTICLES - Displacements, Velocity and acceleration, their relationship – Relative motion – Curvilinear motion – Newton's law – Work Energy Equation of particles – Impulse and Momentum – Impact of elastic bodies.

UNIT- V**9**

FRICTION AND ELEMENTS OF RIGID BODY DYNAMICS - Frictional force – Laws of Coloumb friction – simple contact friction – Rolling resistance – Belt friction-Ladder friction- Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion of bodies.

TOTAL : 45 PERIODS

TEXT BOOK

- 1 Beer, F.P and Johnson Jr. E.R. "Vector Mechanics for Engineers", Vol. 1 Statics and Vol. 2 Dynamics, McGraw-Hill International Edition, 2006 8th edition

REFERENCES

- 1 Rajasekaran, S, Sankarasubramanian, G., "Fundamentals of Engineering Mechanics", Vikas Publishing House Pvt. Ltd., (2007)3rd Edition.
- 2 Hibbeler, R.C., "Engineering Mechanics", Vol. 1 Statics, Vol. 2 Dynamics, Pearson Education Asia Pvt. Ltd., (2000).
- 3 Palanichamy, M.S., Nagam, S., "Engineering Mechanics – Statics & Dynamics", Tata McGraw-Hill, (2001).
- 4 Irving H. Shames, "Engineering Mechanics – Statics and Dynamics", IV Edition – Pearson Education Asia Pvt. Ltd.,(2008).
- 5 Ashok Gupta, "Interactive Engineering Mechanics – Statics – A Virtual Tutor (CDROM)", Pearson Education Asia Pvt., Ltd., (2002).
- 6 Kumar, "Engineering Mechanics" Tata McGraw-hill, 2007, 3rd Edition
- 7 S.S. Bhaikatti, " Engineering Mechanics", New Age International Publishers, 2006
- 8 U.G. Sindhal, " Engineering Mechanics", Galgotia Publishers, 2004.
- 9 Meriam & Kraige, " Engineering Mechanics", Vol 2, 5th Edition, Wiley Student edition,
- 10 V. S. Mokhshi, " Engineering Mechanics", Tata McGraw-Hill, 1999.
- 11 R. S. Kurmi, " Engineering Mechanics", S. Chand Publishers, 2004.

PME413

MANUFACTURING TECHNOLOGY - I

L T P C

3 0 0 3

UNIT- I

9

CASTING PROCESSESS- Introduction to casting - Patterns, Types, Pattern Materials, Pattern Allowances - Moulding - types- Moulding sand, Properties and Requirements of moulding sands, Gating & Riserling, Cores & Core making.

Casting Process - Shell, Investment, Die casting, Centrifugal Casting. Casting Defects

UNIT- II

9

MECHANICAL WORKING OF METALS- Introduction to Hot and Cold Working, Classification, Rolling, Types of Rolling Mills, working principle, Roll Pass, Rolling Defects

Forging, Types, Open Die forging, Impression, Closed Die Forging, Rotary Swaging, Die Materials, Lubrication, Forgeability, Forging Defects.

Wire Drawing, Principles and construction details, Extrusion-Types-Forward, Backward & Tube Extrusion

UNIT – III

9

SHEET METAL FORMING- Forming Operations- Blanking-blank size calculation, draw ratio, drawing force, Piercing, Punching, Trimming, Stretch Forming, Deep Drawing, Shearing, Metal Spinning, Bending, Tube bending, Tube forming - Embossing & Coining, Types of Dies, Progressive, Compound and Combination dies. Forming Methods - Explosive Forming, Electro Hydraulic Forming, Electro Magnetic Forming, Dynapack Machine, Rubber Forming, Super Plastic Forming.

UNIT- IV

9

METAL JOINING PROCESSES- Welding- Classifications - Welding Equipments, power requirement -Electrode Types - Specification, Gas welding - Types, Arc welding- Types, SMAW, Carbon Arc, TIG, MIG, Atomic Hydrogen, Co2 welding, Submerged Arc welding. Special welding Processes- Laser, Electron Beam, Plasma Arc, Ultrasonic, Electro slag, Friction welding, diffusion welding, electrical resistance welding. Soldering, Brazing. Welding Defects - welding inspection and testing.

UNIT- V MANUFACTURE OF PLASTIC COMPONENTS

9

Types and characteristics of plastics – Moulding of thermoplastics – working principles and typical applications – injection moulding – Plunger and screw machines – Compression moulding, Transfer Moulding – Typical industrial applications – introduction to blow moulding – Rotational moulding – Film blowing – Extrusion – Thermoforming – Bonding of Thermoplastics.

TOTAL : 45 PERIODS

TEXT BOOKS

- 1 Sharma. P.C., "A Text book of Production Technology" (Manufacturing Technology) , Sixth Edition, S.Chand & Company Ltd, New Delhi, 2007
- 2 Rao. P.N., "Manufacturing Technology", Metal Cutting & Machine Tools , Tata McGraw Hill Publishing Co, New Delhi, 2007.
- 3 Chapman W.A.J., "Workshop Technology Vol I & II", Arnold Publisher, 1996
- 4 Serope Kalpakjian, Steven R.Schmid "Manufacturing Engineering and Technology" Fourth Edition, 2004, Pearson Education
- 5 Jain.R.K, "Engineering Metrology " Twentieth Edition, Khanna Publishers, 2007

REFERENCE BOOKS

- 1 Banga T.R, Agarwal. R.K. & Manghrani. T.M., "Foundry Engineering", Khanna Publishers, New Delhi, 1995
- 2 Jain.R.K. "Production Technology" Khanna Publishers, 1988

- 3 Bhattacharyya.A. "Metal Cutting Theory and Practice", Central Book Publishers, 1984
- 4 S. K. Hajra Chowdhery, & A. K. Hajra Chowdhery, Elements of Workshop Technology, Vol 1 & 2, Media Promoters and Publishers, 2007, 14th Edition.
- 5 C. Elanchezian, Production Technology, Easwar Press, 2005.

PME4314

MATERIAL SCIENCE & METALLURGY

L T P C

3 0 0 3

UNIT – I

9

Structure of Metal and alloys – Ionic, covalent and metallic bonding – space lattice, crystal structure, miller indices for atomic planes and direction, crystal defects – point line and plane defect, polymorphisms and allotropy grains and grain boundaries and simple problems - strengthening mechanism

Diffusion fick;s law of diffusion , solvation of fick’s second lay and its applications, atomic model of diffusion an role of crystel defects, temperature dependence of diffusion co-efficient. Kirkendall effect.

UNIT – II

9

Mechanical Properties – Tensile test, luder’s band, engineering stress – strain curve. True stress – strain curve, elastic deformation, plastic deformation – effect of mean stresses & notches. Creep test –p primary, secondary & Territory creep failure analysis & factography.

Transformations: General characteristics of martensitec reactions. Similarity to deformation twinning, bain distortion, crystallography & Kinetics of Martensitic transforming examples from ferrous and non-ferrous alloy systems. Order – disorder transformation. Examples of ordered structures, long and short range order, detection of super lattices, influence of ordering on properties.

UNIT – III

9

Phase diagrams – phase rules, solid solutions, inter – metallic components, cooling curves, equilibrium diagram – isomorphous, eutectic, peritectic and eutecoid types – iron – carbon equilibrium diagram. Types of steel, cast iron, slow cooling of steels, tool steel, alloy steel – phase transformation, TTT DIAGRAM, Alloys of Cu, Al, Mg, Ni.

UNIT – IV

9

Heat treatment of steels and non – ferrous materials annealing, normalizing, hardening, tempering – Austempering, Martempering, Case hardening techniques, Hardenability test. Powder metallurgy – processes and applications with examples.

Polymer, fiber, Ceramics and composite materials – high strength alloys, super alloys, alloys of Titanium, Cobalt and their applications. Uncommon materials like Beryllium, Zirconium, Hafnium, Tantalum, Niobium and their applications. Cellular metallic materials, fusible alloy, Bearing materials, Ferromagnetic, Paramagnetic materials. Introduction to nano materials and nano composites.

TOTAL : 45 PERIODS

TEXT BOOKS

1. G.E. DIETER, Mechanical Metallurgy, Mc Graw Hill, ISE.
2. O.P KHANNA, Material Science and Metallurgy, Dhanpat Rai & Sons.2008, 1st Edition

REFERENCES

- 1 S.H.AVENER, Introduction to physical metallurgy, McGraw Hill, ISE
- 2 REYMOND A.HIGGINS, Engineering Metallurgy , ELBS.
- 3 C.SMALLMAN, Modern Physical Metallurgy. English Language Book, Butterworths, London.
- 4 LAWRENCE H. VANVLACK, Elements of Material science and Engineering Addition wiley Publishing Co.,
- 5 RAGHAVAN, Material Science and Engineering ,Prentice Hall India Ltd, 2007 5th Edition.
- 6 MARC ANDRE MEYERS & KRISHNAKUMAR CHAWLA, Mechanical Behaviour of Materials PHI, 1999.
- 7 MICHEL F. ASHBY & DAVID RH. JOFNNNS, Engineering Materials – An Introduction to their properties and Applications – 2nd ed. Butterworths.
- 8 ANIL KUMAR Sinha, Ferrous Physical Metallurgy, Butterworths.
- 9 Material Hand Book, Vol – II, III & IV, ASM, 9th ed.
- 10 James F. Shackel Ford, Introduction to Material Science for Engineers, 2007 6th Edition.
- 11 V. Rajendiran, Material Science, TMH, 2005.
- 12 K.R. Phaneesh, Material Science and Metallurgy, Sudha Publications, 2007. 5th Edition.

UNIT – I**9**

BASIC CONCEPTS - Concept of continuum, macroscopic approach, Thermodynamics systems- Closed, open or control volume. Thermodynamic properties and equilibrium state of a system, State diagram, Path and process, Work, Modes of work, Zeroth law of thermodynamics - Concept of temperature and heat.

FIRST LAW OF THERMODYNAMICS

Application to closed and open system, Internal energy, Specific heat capacities C_v and C_p , Enthalpy, Steady flow process with reference to various thermal equipment.

UNIT - II**9**

SECOND LAW OF THERMODYNAMICS - Kelvin's and Clausius statements of second law of thermodynamics - Reversibility and irreversibility - Carnot cycle, reversed Carnot cycle efficiency, COP - Clausius inequality - Concept of entropy, Entropy of ideal gas, principle of increase of entropy - Carnot theorem.

AVAILABILITY

Reversible Work, Availability, Irreversibility for closed systems and steady state control volumes, II Law Efficiency.

UNIT - III**9**

PROPERTIES OF PURE SUBSTANCES - Thermodynamics properties of pure substance in solid and vapor phases rule - P-V, P-T, T-V, T-S, H-S, Diagrams, PVT surfaces - Steam table of thermodynamics properties - Calculation of properties, work done and heat transferred in non-flow and flow process.

UNIT - IV**9**

THERMODYNAMIC RELATIONS Gibbs and Helmholtz function – General thermodynamic relations - Exact differentials - T-ds relation - Maxwell, Clausius - Clapeyron equation - Joule Thomson coefficient. Third law of thermodynamics.

UNIT - V**9**

PSYCHROMETRY - Properties of moist air - Adiabatic saturation process - Psychrometric charts - Sensible heating and Sensible cooling - Dehumidification, Heating and dehumidification –Cooling & Humidification - Adiabatic mixing of two streams.

TOTAL : 45 PERIODS**TEXT BOOKS**

1. VANWVYLEN & SONNTAG, Classical Thermodynamics – Wiley Eastern.
2. P.K. NAG, Engineering Thermodynamics –Tata –McGraw Hill.4th Edition.

REFERENCES

- 1 ROGER & MAYHEW, Engineering Thermodynamics – Addison Wiley, 2007, 4th Edition
- 2 J.P HOLMAN, Thermodynamics – McGraw Hill, 1995
- 3 MARK. W. ZEMANSKY AND RICHARD H. DITTMAN, Heat and Thermodynamics, McGraw Hill.
- 4 T. ROY CHOUDARY, Basic Engineering Thermodynamics, 1997, TMH
- 5 BRIJLAL N. SUBRAHMANYAM, Heat and Thermodynamics –S. Chand & Co.,
- 6 SPALDING & COLE, Engineering Thermodynamics, ELBS
- 7 MICHAEL SAAD, Thermodynamics, Prentice Hall, 1997
- 8 KENNETH WORK Jr, Advanced Thermodynamics for Engineers,
- 9 Mc Graw Hill, 1995.
- 10 M. S. YADAV, Thermodynamics, Anmol Publications Pvt Ltd, New Delhi. 2000.
- 11 C.P. Arora, Thermodynamics, TMH, 5th Edition.
- 12 S. C. Singhal, Engineering Thermodynamics, CBS Publishers, 2004, 1st Edition.
- 13 Y.V. C Rao, Engineering Thermodynamics, 2005 1st Edition.
- 14 P. L. Ballaney, Thermal Engineering, Khanna Publishers, 2007, 24th Edition.
- 15 R. K. Rajput, Thermal Engineering, Lakshmi Publishers, 2008, 6th Edition.

(Use of approved Thermodynamic property tables like Steam tables, Mollier chart, Psychrometric chart are permitted in all the examinations)

SEMESTER - II

PME421

**APPLIED MATHEMATICS FOR
MECHANICAL ENGINEERS - I**

L T P C

3 1 0 3

UNIT- I INTERPOLATION AND NUMERICAL INTEGRATION

9

Interpolation with equal intervals – Newton’s forward interpolation formula – Newton’s backward interpolation formula - Interpolation with unequal intervals: Lagrange’s interpolation formula, Newton’s divided difference formula - Numerical integration: Trapezoidal rule - Simpson’s one-third rule - Simpson’s three-eighth rule –Outline of applications of interpolation and numerical integration in engineering.

UNIT- II LAPLACE TRANSFORMS AND APPLICATIONS

9

Transforms of elementary functions : $1, t^n, e^{at}, \sin at, \cos at, \sinh at, \cosh at$ - Properties of Laplace transforms: Linearity Property, First shifting property, Change of scale property –Transforms of derivatives - Transforms of integrals - Multiplication by t^n - Division by t - Evaluation of integrals by Laplace transform - Inverse transforms: Method of partial fractions – Other methods of finding inverse - Convolution theorem (Without proof) - Unit step function – Unit Impulse Function -Application to differential equations – Outline of applications of Laplace transforms in engineering.

UNIT- III NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS

9

Picard’s method – Taylor series method - Euler’s method – Modified Euler’s method – Runge’s method – Runge-Kutta method – Predictor-corrector methods: Milne’s method, Adams Bashforth method – Outline of applications of ordinary differential equations in engineering.

UNIT- IV DIFFERENCE EQUATIONS AND APPLICATIONS

9

Formation of difference equations – Linear difference equations – Rules for finding the complementary function – Rules for finding the particular integral – Simultaneous difference equations with constant coefficients – Outline of other applications of difference equations in engineering

UNIT - V Z – TRANSFORM AND APPLICATIONS

9

Standard z-transforms of $1, a^n, n^p$ – Linearity property – Damping rule – Shifting rules – Multiplication by n - Initial and final value theorems (without proof) – inverse z – transforms – Convolution theorem (without proof) – Convergence of z-transforms – Two sided z-transform – Evaluation of inverse z-transforms: Power series method,

Partial fraction method, inversion integral method – Application to difference equations
– Outline of applications of z-transform in engineering.

Note: Questions are to be set on problem solving and not on the theoretical aspects.

TOTAL : 45 PERIODS

TEXT BOOK:

Grewal B.S, Higher Engineering Mathematics, 41st Edition, Khanna Publishers, New Delhi, 2011.

REFERENCES

1. Alan Jeffrey, Advanced Engineering Mathematics, Academic Press
2. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
3. Gerald C.F and Wheatley P.O, Applied Numerical Analysis, Addison-Wesley Publishing Company.

PME422

MECHANICS OF SOLIDS

L T P C

3 1 0 3

UNIT - I

9

Stress & Strain: Concept of stress, axial loading, normal stress, shearing stress, bearing stress, stress on an oblique plane under axial loading, components of stress, ultimate and allowable stress, factor of safety, Concept of strain, normal stress under axial loading, stress-strain diagram, Hook's law, Poission's relation, elastic constants and their relation-mechanical and thermal stresses in simple and composite members, strain energy, resilience, impact load, Saint-Venant's principle-stress concentration.

UNIT II

9

Bending stress in simple and composite beams, biaxial stresses, principle stress & strain, maximum shearing stress, Mohr's circle for plane stresses, Shear stress in a beam of rectangular section, I –section. Shear force and bending moment diagram for determinate beam, cantilever, simply supported and overhanging beams.

UNIT III

9

Slope and deflection of beams by – Double Integration method, Maculay's method, Moment area method, conjugate beam method and strain energy method for determinate beam, Cantilever, Simply supported, Over hanging beam for various types of load with and without applied moment.

UNIT IV**9**

Torsion of circular shaft, strain energy in torsion, stress concentration in torsion, shaft under action of varying torque, hollow shafts, combined bending and twisting of shafts, equivalent bending and twisting moments. Springs: Close coiled helical springs, Open coiled helical springs, Leaf springs, Spiral springs.

UNIT V**9**

Thin cylinder and thin spherical shells – under internal pressure, volumetric strain on capacity.

Column and struts – Combined bending and axial stresses, Euler formula for long columns. Empirical formulae for short columns – Applications.

TOTAL : 45 PERIODS**TEXTBOOKS**

- 1 POPOV E.P, Mechanics of Solids, PHI, New Delhi, 1976
- 2 BEER & JOHNSON, Mechanics of materials, SI Metric Edition, McGraw Hill, ISE
- 3 L.S. SRINATH, Advanced Mechanics of Solids, TMH, 2009, 3rd Edition

REFERENCE BOOKS

- 1 GERE AND TIMENSENKO, Mechanics of Materials, CBS, 1986.
- 2 JACKSON AND WIRTZ, Statics and Strength of Materials, Schaum Series, 1983.
- 3 S. RAMAMRUTHAM AND R. NARAYAN, Strength of Materials, Dhanpat Rai and Sons, New Delhi.2007, 15th Editon.
- 4 RYDER G.H. , Strength of materials by ELBS.
- 5 S.P. TIMOSHENKO J.N GOODIER, Theory of Elasticity, Mc Graw Hill International Edition.
- 6 S.M.A.KAZIMI, Solid Mechanics, Tata McGraw Hill Publishing Company Ltd.
- 7 TIMOSHENKO & YOUNG, Engineering Mechanics, McGraw Hill
- 8 REES DWA. Basic Solid Mechanics, McMillan Press, London, 1997
- 9 Arthur P. Boresi, Advanced Mechanics of Materials, John Wiley & Sons Ltd, 1993, 5th Edition.
- 10 Dr. R. K. Bansal, Strength of Materials, Lakshmi Publishers, 2007, 4th Edition.
- 11 J. B. K Das, Mechanics of Materials, Sapna Book House, 2007.

UNIT – I**9**

Fluid Properties: Fundamental concepts of fluid flow-Viscosity-surface tension-capillarity, compressibility – buoyancy - continuity equation, energy equation and Bernoulli's equation, Flow measuring methods and instruments: Manometer - pitot tube – nozzle – venturimeter – orificemeter - Flow meter for closed conduit systems- Momentum & energy correction factors.

UNIT – II**9**

Momentum and Moment of Momentum equation – Hegan - Poiseulli's equation - Darcy-Weisbach equation - derivation & application, Navier - stoke's equation- Statement and Application - Power Transmission in pipes - Operation of pipes in series and parallel - Operation under Zero flow condition in one pipe.

UNIT - III**9**

Steady, unsteady, uniform, non-uniform, rotational and ir-rotational, laminar and turbulent flows. Source-Sink – Circulation - source or sink with circulation - Uniform flow with source or sink - Doublet - Uniform flow with source, sink and circulation - Half body- Rankine body - Streamlined body - Bluff body - Magnus effect - Lift and Drag coefficient calculations - for ideal and real fluid flow for compressible & Incompressible fluids - Different forms of drag.

UNIT - IV**9**

DIMENSIONAL ANALYSIS AND PUMPS - Dimensional analysis – Buckingham Pi – theorem - Non-dimensional numbers - Dynamic similitude - specific speed – unit quantities.

Centrifugal pump - work done - head developed - Specific energy – Priming - Minimum starting speed - net positive suction head - Performance of multistage pumps - Performance curves – cavitation - working principles and applications of reciprocating , Gear and submergible pumps.

UNIT - V**9**

HYDRAULIC TURBINES - Hydraulic turbines – Classification - working principles - Pelton wheel, Kaplan turbines - Francis turbines - velocity triangles - theory of draft tubes – Performance - Selection of turbines - governing of turbines - method of preventing hydraulic coupling - Torque converters.

TOTAL : 45 PERIODS**TEXTBOOKS**

- 1 H.R. VALLENTINE, Applied Hydrodynamics, S.I. Edition, ELBS, 1970.
- 2 J.F.DOUGLAS, J.M.GASIOREK AND J.ASWAFFIELD, Fluid Mechanics, ADDISON WILEY 1999.
- 3 K.L. KUMAR, Fluid Mechanics, TMH.

REFERENCES

- 1 VICTOR L. STREETER AND BENJAMIN WYLIE & KIETH W.BEDFORD, Fluid Mechanics, Mc Graw Hill 1999.
- 2 DOUGLAS, J.F, Solving Problems in Fluid Mechanics Vol I and Vol II, ELBS, 1986.
- 3 SHAMES, Mechanics of fluids, McGraw Hill ISE.
- 4 A.H CHURCH AND JAGDISH LAL, Centrifugal Pumps and Blowers, Metropolitan Book Company Pvt. Ltd., ND 1973.
- 5 MODI P.N SETH, Hydraulics, Fluid Mechanics & Machinery, Standard Book House. 2007, 16th Edition.
- 6 R.K BANSAL, Fluid Mechanics & Hydraulic Machines. 2008, 9th Edition.
- 7 K.SUBRAMANIA, Theory and application of Fluid Mechanics, TMH (P) Ltd., N.Delhi – 1993.
- 8 BISWAS, Introduction to Fluid Mechanics and Fluid Machines, TMH
- 9 Dr. K. R. Arora, Fluid Mechanics Hydraulics and Hydraulic Machines, Standard Publishers, 2007, 9th Edition.
- 10 S. K. Som, G. Biswas, Introduction to Fluid Mechanics and Fluid Machines, TMH, 2008, 2nd Edition.
- 11 M. K. Natarajan, Principles of Fluid Mechanics, Oxford & IBH Publishing Company P Ltd, 1999, 2nd Edition.
- 12 C. P. Kothandaraman, Fluid Mechanics and Machinery, New Age Publishers, 2007, 2nd Edition.

PME424

MANUFACTURING TECHNOLOGY - II

**L T P C
3 0 0 3**

OBJECTIVES:

- To understand the concept and basic mechanics of metal cutting, working of standard machine tools such as lathe, shaping and allied machines, milling, drilling and allied machines, grinding and allied machines and broaching.

UNIT - I THEORY OF METAL CUTTING

9

Mechanics of chip formation, single point cutting tool, forces in machining, Types of chip, cutting tools – nomenclature, orthogonal metal cutting, thermal aspects, cutting tool materials, tool wear, tool life, surface finish, cutting fluids and Machinability.

UNIT - II TURNING MACHINES

9

Centre lathe, constructional features, specification, operations – taper turning methods, thread cutting methods, special attachments, machining time and power estimation. Capstan and turret lathes- tool layout – automatic lathes: semi automatic – single spindle : Swiss type, automatic screw type – multi spindle:

UNIT - III RECIPROCATING, MILLING AND GEAR CUTTING MACHINES 9

Reciprocating machine tools: shaper, planer, slotter: Types and operations- Hole making : Drilling ,reaming,boring,Tapping, Milling operations-types of milling cutter – attachments- machining time calculations -,Gear cutting – forming and generation principle, gear milling , hobbing and gear shaping – micro finishing methods

UNIT – IV ABRASIVE PROCESS AND BROACHING 9

Abrasive processes: grinding wheel – specifications and selection, types of grinding process

– cylindrical grinding, surface grinding, centreless grinding, internal grinding- micro finishing methods - Typical applications – concepts of surface integrity, broaching machines: broach construction – push, pull, surface and continuous broaching machines

UNIT- V NON TRADITIONAL MACHINING PROCESS 9

- Introduction, Classification, Applications, Benefits, Construction and working Principle of Various Processes - Abrasive jet machining Electrical discharge machining, Wire cut EDM Process, Electro chemical machining, Electro chemical grinding, Electron beam machining, Laser beam machining, Plasma jet machining.

TOTAL : 45 PERIODS

TEXT BOOKS

- 1 Milton C.Shaw “ Metal Cutting Principles” Oxford Science Publications, 1997
- 2 Juneja B.L , Fundamentals of Metal Cutting and Machine Tools, 2nd Edition, New Age Internal Publishers,2005
- 3 Sharma. P.C., "A Text book of Production Technology" (Manufacturing Technology) , Sixth Edition, S.Chand & Company Ltd, New Delhi, 2007
- 4 Serope Kalpakjian, Steven R.Schmid "Manufacturing Engineering and Technology" Fourth Edition, 2004, Pearson Education
- 5 Sharma.P.C. “ A Text Book of Production Engineering “ Tenth Edition, S.Chand & Company Ltd, New Delhi, 2002.

REFERENCES

- 1 Rao. P.N., "Manufacturing Technology", Metal Cutting & Machine Tools , Tata McGraw Hill Publishing Co, New Delhi, 2000.
- 2 ROY. A LINDBERG, Process and Materials of Manufacture, PHI, New Delhi.
- 3 PAUL RANKY, Introduction to Flexible Manufacturing Systems.
- 4 W. A. J CHAPMAN, Workshop Technology, Arnold publishers Vol - III
- 5 R.K. JAIN. Production Technology, Khanna Publishers
- 6 M.HASTLE HURST, Manufacturing Technology, ELBS
- 7 Hazra Choudhury S.K & Hazra Choudhury A.K, Elements of Manufacturing Technology, Vol-II, Media Publications.
- 8 C. Elanchezhian, Production Technology, Easwar Press, 2005.

Unit - I**9**

Need for object oriented programming, Characteristics of object oriented language - objects, classes, Inheritance, Reusability, creating new data types, Polymorphism and overloading C++ programming basics – Data types, Manipulators, Cin, Cout, Type conversion, arithmetic operators, Loops and decisions.

Unit – II**9**

Class and objects : A simple class, C++ Objects as physical Objects, C++ Objects as Data Types, Constructors, destructors, objects as function arguments, overloaded constructors, member functions defined outside the class, inline functions.

Unit -III**9**

Arrays: Defining & accessing Array elements, arrays as class member data, array of Objects. Operator Overloading: Overloading Unary Operators, postfix notations. Overloading Binary Operators - Arithmetic operators, Concatenating Strings, Arithmetic Assignment Operators.

Unit – IV**9**

Inheritance-Derived class and base class, derived class constructors, overriding member functions, Class Hierarchies, Abstract base class, Public and private inheritance, Levels of inheritance, Multiple inheritance. Memory management – new and delete operator, a string class using new, Pointers to Objects – An array of pointers to Objects.

Unit - V**9**

Virtual Functions – Pure virtual functions, Late Binding, Abstract Classes, Virtual base classes. Friend Functions, Static Functions, the copy constructor, the this pointer. Templates, function templates, class template.

TOTAL : 45 PERIODS**TEXT BOOKS**

1. Object Oriented Programming in Microsoft C++ - Robert Lafore, Galgotia Publication Pvt Ltd.
2. Let us C++ - Yaswant Kanitkar (used for templates) ,BPB Publication

REFERENCE BOOKS

1. Object Oriented Programming in C++ - E. Balaguruswamy, Tata Mcgraw Hill.
2. Teach yourself C++ - Herbertsehildt, OSBORNE/MH

SEMESTER - III

PME431

**APPLIED MATHEMATICS FOR MECHANICAL
ENGINEERS - II**

L T P C

3 1 0 3

UNIT - I APPLICATIONS OF LINEAR DIFFERENTIAL EQUATIONS 9

Simple harmonic motion – Simple pendulum – Gain or loss of oscillations – Oscillations of a spring: Free oscillations, Damped oscillations, Forced oscillations (without damping), Forced oscillations (with damping) – Oscillatory electrical circuit – Electro-Mechanical analogy – Deflection of beams – Whirling of shafts – Applications of simultaneous linear equations

UNIT – II PARTIAL DIFFERENTIAL EQUATIONS 9

Formation of partial differential equations – Solution of a partial differential equation – Equations solvable by direct integration – Linear equations of first order – Non linear equations of the first order – Charpit's method - Homogeneous linear equations with constant coefficients –Rules for finding complementary functions – Rules for finding particular integral – Solution of homogeneous linear equation of any order.

UNIT- III NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS 9

Classification of second order equations – Finite difference approximation to derivatives – Elliptic equations: Laplace Equation, Poisson's equation – Solution of Laplace's equation – Solution of Poisson's equation – Parabolic equations: Heat equation – Solution of heat equation – Hyperbolic equations: Wave equation – Solution of wave equation – Outline of applications of numerical solution of partial differential equations in engineering.

UNIT –IV APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 9

Method of separation of variables – Vibration of a stretched string: Wave equation – Solution of Wave equation - D'Alembert's solution of wave equation – One dimensional heat flow – Solution of heat equation – Two dimensional heat flow – Solution of Laplace equation: temperature distribution in long plates, Temperature distribution in finite plates.

UNIT- V COMPLEX INTEGRATION 9

Integration of complex functions – Cauchy's theorem (without proof) – Cauchy's integral formula (without proof) –Taylor's series (without proof)– Laurent's series (without proof) – Zeros and Singularities of an analytic function – Residues – Residue theorem (without proof) – Calculation of residues – Evaluation of real definite integrals:

Integration around the unit circle, Integration around a small semi circle, Integration around rectangular contours, Indenting the contours having poles on the real axis – Outline of applications of complex integration in engineering.

Note: Questions are to be set on problem solving and not on the theoretical aspects.

TOTAL : 45 PERIODS

PRESCRIBED TEXT BOOK

Grewal B.S, Higher Engineering Mathematics, 41st Edition, Khanna Publishers, New Delhi, 2011.

REFERENCES

1. Brown J.W, Churchill R.V, Complex Variables and Applications, McGraw Hill
2. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons
3. Gerald C.F and Wheatley P.O, Applied Numerical Analysis, Addison-Wesley Publishing Company

PME432

KINEMATICS OF MACHINES

L T P C

3 1 0 4

UNIT - I

9

Links, Pairs, Chains, Mechanisms, Inversion of machines, Structure - Degrees of freedom, inversion, Four bar chains. Velocity and acceleration: Velocity and acceleration of simple mechanism by relative velocity method. Klein's constructions for slider crank chain oscillating cylinder and swivel bearing mechanisms. Analytical solution for slider crank mechanisms.

UNIT - II

9

Cams: Types of cams and followers, displacement, velocity & acceleration curves for uniform velocity, uniform acceleration and retardation. SHM, cycloidal curves, lay out of profile of plate cams of the above types with reciprocating and oscillating followers – knife edge rollers and flat faced followers, cylindrical and face cams, polynomial cams, cams with special contours.

UNIT - III

9

Theory of gearing: Toothed gears, minimum number of teeth, length of arc of contact, interference.

UNIT - IV

9

Gear trains: Types, velocity ratio and torque calculation in epicyclic gear trains and differential gear train.

UNIT - V

9

Belt and rope drives, single plate, multiple plate, cone clutches, power transmitted, Brakes. Lubrication: Theory of lubrication, hydrostatic and hydrodynamic bearings, frictional loss, power in bearing.

TOTAL : 45 PERIODS

TEXTBOOKS

- 1 AMITABH GHOSH AND ASHOK KUMAR MALLIK, Theory of mechanism and Machines – 3rd Edition, Affiliated East West Press Limited, 2007.
- 2 J.E.SHIGLEY AND J.J.VICKER Jr. Theory of Machines and Mechanism, 2nd ed. Mc GrawHill ISE 1995
- 3 R.S. KHURMI & GUPTA .J.K, A text book of Theory of Machines, S. Chand & Co., 2008, 14th Edition.
- 4 G.K.GROVER, Mechanical Vibrations, New Chand and Brothers, Roorkee.

REFERENCES

- 1 J.HANNAH AND R.C STEPHENS ARNOLD, Mechanics of Machines – ISE 1986.
- 2 BEER & JOHNSTON 5TH Edition, Vector Mechanics for Engineers. McGraw Hill. ISE 1988.
- 3 THOMAS BEVAN – 3rd Edition, The Theory of Machines – CBS 1984.
- 4 P.L.BALLANEY, Theory of Machines, Khanna Publishers, 2005, 24th Edition.
- 5 S.S.RATTAN, Theory of Machines, TMH. 2008, 2nd Edition.
- 6 RAO .J.S. & DUKKIPATI. R.V. Mechanism and Machine Theory, 2nd ed. Wiley Eastern Ltd., 2007,
- 7 HAMILTON H. MABIE & CHARLES F. REINNOLTZ, Mechanisms and Dynamics of Machinery, 4th ed. John Wiley & Sons, 1995
- 8 THOMSON W.T, Theory of Vibration and Applications, PHI, 1975
- 9 Sadhu Singh, Theory of Machines, Pearson Education Ltd, 2007.
- 10 Ashok G. Ambekar, Mechanism and Machine Theory , Eastern Economy Edition. 2007.
- 11 John. J. Uicker, Theory of Machines and Mechanisms, Oxford University Press, 2008, 3rd Edition.

UNIT - I**9**

FLOW THROUGH NOZZLE - One-dimensional flow of steam through Convergent - Divergent Nozzle - Critical pressure ratio, super saturated flow in nozzles.

STEAM TURBINES - Impulse and Reaction turbine Principles - Compounding – Types - Velocity diagrams for simple and multistage turbines - Speed regulations – Governors.

UNIT - II**9**

GAS POWER CYCLES - Air Standard Cycles - Otto, Diesel, Dual, Brayton ,Gas turbine cycle Analysis - methods of cycle improvement. Regenerative, intercooled, reheated cycles and their combinations - performance calculations.

UNIT - III**9**

REFRIGERATION - Refrigeration cycles- Reversed Carnot cycle - Vapour compression system - Vapour absorption refrigeration system- Properties of refrigerants – Multi pressure refrigeration systems- Gas cycle refrigeration, ejector compression refrigeration systems - Refrigeration equipments – Compressors - Condensers - Expansion devices - Evaporators.

UNIT - IV**9**

RECIPROCATING AIR COMPRESSORS - Working principle – work done - Effect of clearance volume - Single and multi stage compressors, Volumetric efficiency – Intercooling in multistage compressors, calculation of power requirement – Rotary compressors.

UNIT- V**9**

AIR CONDITIONING - Principles of air-conditioning - Types of A/C Systems - Summer, Winter - Comfort and Year round air conditioners – Window & Centralised A/c - heat load calculations – Concept of GSHF – RSHF - ESHF

TOTAL : 45 PERIODS**TEXT BOOKS**

1. VANWVYLEN & SONNTAG, Classical Thermodynamics – Wiley Eastern.
2. P.K. NAG, Engineering Thermodynamics –Tata –McGraw Hill.4th Edition.
3. ROGER & MAYHEW, Engineering Thermodynamics – Addison Wiley, 2007, 4th Edition
4. J.P HOLMAN, Thermodynamics – McGraw Hill, 1995
5. Y.V. C Rao, Engineering Thermodynamics, 2005 1st Edition.
6. P. L. Ballaney, Thermal Engineering, Khanna Publishers, 2007, 24th Edition.
7. R. K. Rajput, Thermal Engineering, Lakshmi Publishers, 2008, 6th Edition.

REFERENCES

1. MARK. W. ZEMANSKY AND RICHARD H. DITTMAN, Heat and Thermodynamics, McGraw Hill.
2. T. ROY CHOUDARY, Basic Engineering Thermodynamics, 1997, TMH
3. BRIJLAL N. SUBRAHMANYAM, Heat and Thermodynamics –S. Chand & Co.,
4. SPALDING & COLE, Engineering Thermodynamics, ELBS
5. MICHAEL SAAD, Thermodynamics, Prentice Hall, 1997
6. KENNETH WORK Jr, Advanced Thermodynamics for Engineers,
7. Mc Graw Hill, 1995.
8. M. S. YADAV, Thermodynamics, Anmol Publications Pvt Ltd, New Delhi. 2000.
9. C.P. Arora, Thermodynamics, TMH, 5th Edition.
10. S. C. Singhal, Engineering Thermodynamics, CBS Publishers, 2004, 1st Edition.

(Use of approved Thermodynamic property tables like Steam tables, R & A/C Mollier chart, Psychrometric chart are permitted in all the examinations)

PME434

APPLIED ELECTRICAL & ELECTRONICS ENGINEERING

L T P C

3 0 0 3

UNIT- I ELECTRIC DRIVES:

9

DC MACHINES AND TRANSFORMERS: DC motors and Transformers– methods of excitation, Speed-torque characteristics-auto transformer – three phase connections – parallel operation of transformers – phase conversion – tap changing.

AC MACHINES: Induction Machines - Single phase and three phase Induction motors, double revolving field theory, Speed-torque characteristics, Synchronous machines-Types.

UNIT- II SPECIAL MACHINES AND INDUSTRIAL APPLICATIONS

9

Shaded – Pole induction motor –hysteresis motor – AC series motor – repulsion motor – linear motor – permanent magnet DC and AC motors.

Selection factors for the motors, Power rating of drive motors, Selection of motors for Cranes, Machine tool applications and Centrifugal pumps.

UNIT- III ELECTRONIC CIRCUITS:

9

Semiconductors, diodes, transistors and Rectifier, Capacitive filters, Zener voltage regulator, RC- DMA - Diac, Triac, Switching transistors - Concept of feedback- Negative and Positive feed back – RC phase shift, Hartley, Colpit's, Wien bridge oscillators.

UNIT- IV DIGITAL ELECTRONICS AND MICROPROCESSOR 9

Operational Amplifier and its Characteristics – Voltage to Current Converter - Current to Voltage Converter - Schmitt trigger circuit- Astable Multivibrator - DAC – ADC. Architecture of 8085-Pin configuration-Instruction set- Format & Types -Addressing modes- machine cycles, timing and memory diagrams, Memory Mapped I/O– Stack and Subroutines.-Simple programs using arithmetic and logical operations.

UNIT- V INTERFACING AND APPLICATIONS OF MICROPROCESSOR 9

Basic interfacing concepts - Interfacing of Input and Output devices, Programmable Peripheral Interface IC 8255

Applications of 8085 Microprocessor: Temperature control, Stepper motor control, traffic light control – Electronic weighing system, Data Logger.

TOTAL : 45 PERIODS

TEXT BOOK

- 1 Nagrath I. J and Kothari D. P. 'Electric Machines', Tata McGraw Hill Publishing Company Ltd, 1990.
- 2 B.L.Theraja & A.K.Theraja, "Electrical Technology" , Vol – II, S.Chand Company Ltd, New Delhi, 2007.
- 3 G.K Mitthal Electronic Devices and Circuits. Khanna Publications .
- 4 Ramesh Goankar, "Microprocessor Architecture", Programming and Applications with 8085, Wiley Eastern, 1998.

REFERENCES

- 1 Fitzgerald,A.E.Charles Kingsley Jr.Stephen D.Umans, 'Electric Machinery', McGraw-Hill Book Company,1992
- 2 Syed A.Nassar, 'Electric Machines and Power System', Volume I, McGraw-Hill Inc., New York, 1995.
- 3 Nagrath,I.J.and Kothari.D.P., 'Electric Machines', T.M.H publishing Co Ltd., New Delhi 1990.
- 4 Milman and Halkias, "Integrated Electronics", Tata McGraw-Hill publishers, 1995.
- 5 Roi Chowdry, Shalltain and Jain "Linear Integrated Circuits", Wiely Eastern M.Morris Mono – Digital Logic & Computer Design – PHI, II Edn, 1999
- 6 .Douglas V.Hall, "Microprocessor and Interfacing", Programming and Hardware, Tata McGraw-Hill, 1999.

SEMESTER - IV

PME441

**APPLIED MATHEMATICS FOR
MECHANICAL ENGINEERS - III**

L T P C

3 1 0 3

UNIT- I FOURIER SERIES

9

Euler's Formulae (Without Proof) – Condition for Fourier expansion – Functions having points of discontinuity – Change of interval – Expansions of even and odd functions - Half-Range series – Parseval's formula (without proof) – Root mean square value (without proof) – Typical waveforms (Definition Only): Square wave form, Saw toothed waveform, Modified saw toothed waveform, Triangular waveform, Half wave rectifier, Full wave rectifier - Outline of applications of Fourier series in engineering

UNIT – II CALCULUS OF VARIATIONS

9

Functionals – Euler's Equation - Solutions of Euler's equation – Geodesics – Isoperimetric problems – Several dependant variables – Functionals involving higher order derivatives – Approximate solution of boundary value problems: Rayleigh-Ritz method.

UNIT- III COLLECTION AND ANALYSIS OF DATA

9

Classification and tabulation of data - Frequency tables - Graphical representation - Measures of central tendency : Averages, mean, median, mode, Geometric and harmonic means - Measures of dispersion : Range, quartile deviation, Mean deviation, Standard deviation - Relative distribution - Moments - Skewness - Kurtosis - Linear correlation - Coefficient of correlation - Grouped data : calculation of correlation coefficient - Rank correlation - Linear regression - Regression lines.

UNIT – IV ANALYSIS OF TIME SERIES

9

Measurement of trend: Freehand method, Semi-average method, Moving average method, Method of least squares – Measuring trends by logarithms – Measurement of seasonal variations: Method of simple averages, Ratio-to-trend method, Ratio-to-moving average method, Link relative method – Measurement of cyclic variations: Residual method, Reference cycle analysis method, Direct method, Harmonic analysis method – Measurement of irregular variations – Outline of applications of analysis of time series in engineering.

Parameters and statistics – Sampling distribution – Tests of hypothesis and tests of significance – Critical region and level of significance – Errors in testing of hypothesis – One tailed and two tailed tests – Procedure for testing of hypothesis – Design of experiments – Completely randomized design: Analysis of variance for one factor of classification – Randomized block design: Analysis of variance for two factors of classification – Latin square design: Analysis of variance for three factors of classification – Outline of applications of design of experiments in engineering.

Note: Questions are to be set on problem solving and not on the theoretical aspects.

TOTAL : 45 PERIODS

PRESCRIBED TEXT BOOKS

- 1 Grewal B.S, Higher Engineering Mathematics, 41st Edition, Khanna Publishers, New Delhi, 2011.
- 2 Gupta S.P, Statistical Methods, 31st Edition, Sultan Chand and Sons., New Delhi, 2002.

REFERENCES

- 1 Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons
- 2 Forsyth, Calculus of variations, Cambridge.
- 3 Snedecor George W. Cochran William G, Statistical Methods, Affiliated East West Press.

PME442**HEAT AND MASS TRANSFER****L T P C****3 0 0 3****UNIT- I****9**

CONDUCTION - Introduction to conduction heat transfer, Fourier's law of conduction, thermal conduction equation – derivation in Cartesian, cylindrical coordinates. One dimensional steady state conduction in plane wall and composite wall – thermal resistance, electrical analogy. Radial system – cylinder, sphere. Convective boundary condition, overall heat transfer coefficients, critical thickness of insulation, heat generation in plane wall, cylinder and sphere. Conduction and convective system – fins with different boundary conditions, thermal contact resistance, variable conductivity.

UNIT- II**9**

CONDUCTION IN TWO DIMENSION - Steady state conduction in two dimension, conduction shape factor numerical method of analysis, unsteady state conduction – Lumped heat capacity system, significance of Biot and Fourier numbers, transient heat flow in a semi-infinite solid, use of Heisler and Grober charts. Heat transfer in multi dimensional system,

UNIT - III**9**

CONVECTION - Review of boundary layer and thermal boundary layer. Differential and integral equation for hydrodynamic and thermal boundary layer. Similarity between heat, mass and momentum boundary layer. Significance of non-dimensional number in convection. Dimensional analysis for free and forced convection.

FORCED CONVECTION - Heat transfer from flat plate, flow through pipes, use of empirical relations.

FREE CONVECTION - Heat transfer from vertical, horizontal and inclined surfaces.

UNIT - IV**9**

RADIATION - Nature of thermal radiation, Black body concept, Grey body, Radiation shape factor, Relationship between shape factor, radiation heat transfer between two surfaces, Electrical analogy, reradiating surface, radiation shield, gas radiation, heat exchange between gas volume and enclosure.

UNIT - V**9**

HEAT EXCHANGER- Types of heat exchangers – shell and tube, one – pass, two – pass, multi-pass, double-pipe, fouling factor, overall heat transfer co-efficient, LMTD and NTU Methods.

Phase change heat transfer – boiling –condensation.

Mass Transfer – convective and diffusion mass transfer- fick's law- equimolar counter diffusion- isothermal evaporation of water into air.

TOTAL : 45 PERIODS**TEXT BOOKS:**

- 1 J.P.HOLMAN, Heat Transfer – SI Metric ed. McGraw Hill, ISE, 2002, 9th Edition.
- 2 NECATI M. OZISIK, Heat Transfer, McGraw Hill, ISE, 1998
- 3 KOTHANDARAMAN C.P, Fundamentals of Heat & Mass Transfer, New Age International, 2007, 3rd Edition.

REFERENCES:

- 1 CHAPMAN, Heat Transfer – Maxwell McMillan ISE, 1986.
- 2 BIJHON, Convective Heat Transfer – John Wiley.
- 3 Schaum Series, Heat Transfer, McGraw Hill, ISE

- 4 SACHDEVA R.C, Heat and Mass Transfer, New Age International (P) Ltd., 2007, 2nd Edition.
- 5 T. K. BASE, Numerical Fluid Dynamics, Narasa Publishing House, New Delhi, 1997.
- 6 ARTHOR P. FRAAS, Heat Exchanger Design, John Wiley & Sons, 1997.
- 7 Frank Kreith, Principles of Heat Transfer, Thomson India Edition, 2001.
- 8 S. P. Venkatesan, Heat Transfer, Ane Books, 2004.
- 9 Kern, Process Heat Transfer, TMH, 2007.
- 10 Y. V. C. Rao, Heat Transfer, University Press, 2001.
- 11 Domkundwar, Heat and Mass Transfer, Dhanpat Rai India Ltd, 2008, 7th Edition.

TOTAL : 45 PERIODS

(Use of approved Heat and Mass transfer Data book & Steam Tables permitted for all examinations)

PME443	DYNAMICS OF MACHINES	L T P C
		3 1 0 4
UNIT -I		9
BALANCING – Static and dynamic balancing of rotating masses in different planes, partial balancing of reciprocating masses of in – line, V, W and radial engines. Hammer blow and swaying couple in locomotive, direct and reverse crank method.		
UNIT – II		9
INERTIA FORCE – Inertia force and inertia torque calculation. Turning moment diagrams, reciprocating engine mechanisms, fluctuation of energy and speed, Weight of flywheels.		
UNIT -III		9
GOVERNORS AND GYROSCOPE – Function of governors – porter, proell and spring-loaded governors, sensitivity, stability, hunting and isochronisms, effect of friction, calculation of equilibrium speeds and ranges of speed of governors. Gyroscope – couple and effect, in ship and motor cycle, car, aircraft and space vehicles, Gyroscope stabilization.		
UNIT -IV		9
FREE VIBRATION – Undamped free vibration of single degree of freedom system, simple pendulum, compound pendulum, inclined spring-mass system, equivalent stiffness of spring combinations – springs in series, springs in parallel, combined series and parallel springs. Damped free vibration of single degree of freedom systems, types of damping, free vibrations with viscous damping, critically damped system, under damped system.		

FORCED VIBRATION – Forced vibration of single degree of freedom system. Constant harmonic excitation, steady state vibration, magnification factor with frequency ratio for various damping.

Transverse vibrations of beams –natural frequency by energy method, Dunkerly method-Vibration isolation and transmissibility, whirling of shafts.

Torsional vibrations: Torsional vibrations of single and multiple rotor systems, Equivalent shafts, Geared systems, Holzer's method.

TOTAL : 45 PERIODS

TEXTBOOKS

- 1 AMITABH GHOSH AND ASHOK KUMAR MALLIK, Theory of mechanism and Machines – 3rd Edition, Affiliated East West Press Limited, 2007.
- 2 J.E.SHIGLEY AND J.J.VICKER Jr. Theory of Machines and Mechanism, 2nd ed. Mc GrawHill ISE 1995
- 3 R.S. KHURMI & GUPTA .J.K, A text book of Theory of Machines, S. Chand & Co., 2008, 14th Edition.
- 4 G.K.GROVER, Mechanical Vibrations, New Chand and Brothers, Roorkee.

REFERENCES

- 1 J.HANNAH AND R.C STEPHENS ARNOLD, Mechanics of Machines – ISE 1986.
- 2 BEER & JOHNSTON 5TH Edition, Vector Mechanics for Engineers. McGraw Hill. ISE 1988.
- 3 THOMAS BEVAN – 3rd Edition, The Theory of Machines – CBS 1984.
- 4 P.L.BALLANEY, Theory of Machines, Khanna Publishers, 2005, 24th Edition.
- 5 S.S.RATTAN, Theory of Machines, TMH. 2008, 2nd Edition.
- 6 RAO .J.S. & DUKKIPATI. R.V. Mechanism and Machine Theory, 2nd ed. Wiley Eastern Ltd., 2007,
- 7 HAMILTON H. MABIE & CHARLES F. REINNOLTZ, Mechanisms and Dynamics of Machinery, 4th ed. John Wiley & Sons, 1995
- 8 THOMSON W.T, Theory of Vibration and Applications, PHI, 1975
- 9 Sadhu Singh, Theory of Machines, Pearson Education Ltd, 2007.
- 10 Ashok G. Ambekar, Mechanism and Machine Theory , Eastern Economy Edition. 2007.
- 11 John. J. Uicker, Theory of Machines and Mechanisms, Oxford University Press, 2008, 3rd Edition.
- 12 S. S. Rao, Mechanical Vibrations, Pearson Education, 2007, 4th Edition.
- 13 J. B. K. Das, Dynamics of Machinery, Sapna Book House, 2007.

UNIT - I BASIC CONCEPTS

9

Measurement system elements, Experimental Test Plan- Random Tests, Replication & repetition, Calibration - Sensitivity, Range, Accuracy, Standards, Traceability. Measurement Systems Models - First order systems, second order systems, Transfer functions- Signal flow graphs, Block diagram algebra

UNIT - II METROLOGY

9

Interferometry - Slip gauges, Comparators, Abbe's principle, Pneumatic transducer, Electronic transducers, Angle Measurement- Sine bar, angle gauges Optical instruments- Profile projectors, Autocollimators. Surface finish- Parameters, Stylus instruments. Limits and fits, Tolerance of gauges, Evaluation of geometric tolerances, Screw thread measurements, Gear measurements. Coordinate Measuring Machines- Construction, Operations, types and applications. Machine Vision.

UNIT - III PRESSURE, TEMPERATURE AND STRAIN MEASUREMENTS

9

PRESSURE MEASUREMENT: Gravitational, Bourdon, Elastic transducers, strain gauge, Pressure cells, Measurement of high and low pressure,
TEMPERATURE MEASUREMENT- Expansion thermometers, Resistance Temperature Detectors, Thermistors, Thermocouples, Radiative measurements.
STRAIN MEASUREMENT- Strain gauges, types, surfaces preparation and bonding technique, Wheatstone Circuit, Temperature compensation, Gauge rosettes, Calibration.

UNIT- IV FLOW, DENSITY AND VISCOSITY MEASUREMENTS

9

FLOW MEASUREMENT: Orifice, Flow nozzle, Venturi, Pitot tube, Rotometer, Turbine type Anemometer, Hot-wire anemometer, Magnetic flow meter, Ultrasonic flow meter.
DENSITY MEASUREMENT: Phenometer, Hydrometer, differential bubbling, Liquid level Measurements.
VISCOSITY MEASUREMENT: Capillary tube viscometer, efflux viscometer, falling sphere viscometer, Rotating cylinder viscometer.

UNIT- V HUMIDITY, VIBRATION, FORCE AND TORQUE MEASUREMENTS

9

HUMIDITY MEASUREMENT: Sling psychrometer, Absorption hydrometer, Dew point meter.
VIBRATION MEASUREMENT: Vibrometer and different types of accelerometer.
FORCE MEASUREMENT: Scales & balance, Elastic force meter, Strain gauge, Load cells Hydraulic and pneumatic load cells.
TORQUE MEASUREMENT: Mechanical torsion meter, Optical torsion meter, Electrical torsion meter, Strain gauge torsion meter.

TOTAL : 45 PERIODS

TEXTBOOKS

- 1 Gupta.I.C., "Engineering Metrology", Dhanpatrai Publications, 2005.
- 2 C. V.COILETE & AD. HOPE, Engineering Measurements, 2nd ed. ELBS.
- 3 THOMAS G. BECKWITH. N. LEWIS BUCK. ROY D. MARARGONJ, Mechanical Measurements, Narosa Publishing House 2008, 6th Edition, New Delhi.

REFERENCES

- 1 Jain R.K., "Engineering Metrology", Khanna Publishers, 2005
- 2 Shotbolt, "Metrology for Engineers, McGraw Hill, 1990.
- 3 SIROHI RS. & RADHAKRISHNAN H.C, Mechanical Measurement, New Age International (P) Ltd., 2005, 3rd Edition.
- 4 RANGAN C.S, SARMA G.S & MANI VSV, Instrumentation Device and Systems, TMH, 1989
- 5 DOEBLIN, Measurement Systems Application and Design, TMH, 1990
- 6 A. K. Sawhney, Mechanical Measurements and Instrumentation, Dhanpat Rai & Company (P) Ltd, 2007, 12th Edition
- 7 R.K. Jain, Mechanical and Industrial Measurements, Khanna Publishers, 2004, 12th Edition.

LIST OF EXPERIMENTS**I.C.ENGINES:**

- 1 Load test on single cylinder petrol engine
- 2 Performance test on high speed diesel engine with alternator loading
- 3 Performance test on slow speed – diesel engine
- 4 Performance test on high speed – twin cylinder diesel engine
- 5 Performance characteristic and Morse test on a multi cylinder petrol / diesel engine

HEAT TRANSFER:

- 6 Heat transfer through composite wall
- 7 Heat transfer under natural convection
- 8 Heat transfer under forced convection
- 9 Heat transfer through a pin fin
- 10 Parallel / counter flow heat exchanger
- 11 Stefan – Boltzman apparatus
- 12 Emissivity measurement
- 13 Shell & tube Heat Exchanger
- 14 Performance analysis of vapour Compression Refrigeration system

TOTAL : 45 PERIODS

SEMESTER V

PME451

POWER PLANT ENGINEERING

L T P C

3 0 0 3

UNIT - I

9

POWER PLANT EQUIPMENT - Essential of steam power plant equipment – power station design – characteristics of steam power plant – layout – Stokers - Types– pulverized fuel firing – principles of FBC – Types of FBC – Arrangement of different FBC plants – advantages of FBC systems – Ash handling – dust collectors – draft measurements – chimneys – calculation of chimney heights – feed water treatment – air preheater – types of superheaters, condenser, cooling towers.

UNIT - II

9

STEAM GENERATORS - Boilers – types of modern high pressure boiler – boiler mountings and accessories – thermal efficiency of boiler – boiler performance – selection of fuel for boiler – boiler maintenance – selection of boiler – heat balance sheet for boiler – Indian boiler act.

UNIT - III

9

POWER PLANT LAYOUTS - Gas turbine power plant layout

Classification or comparison of different types of gas turbine power plants – different arrangements of plant components – governing system for gas turbine power plant.

Diesel power plant layout

Different systems of diesel power plant – advantages & disadvantages of diesel power plant over thermal plant

Hydroelectric power plant layout

Classification – storage reservoir plants – pump storage plants – advantages of hydro-electric power plants.

MHD power plant

UNIT - IV

9

NUCLEAR POWER PLANT - Nuclear Reactor: General components of nuclear reactors – different types of reactors – pressurized water reactor (PWR), Boiling water reactors (BWR), heavy water cooled and moderated - reactors, gas cooled reactors, liquid metal cooled reactors, fast breeder reactors, location of nuclear power plant, comparison of nuclear power plants with thermal plants. Nuclear materials – fuels – coolant – moderators & reflecting materials – control rod – shielding materials.

UNIT - V**9**

POWER PLANT ECONOMICS - Load curves – different terms & definitions – effect of variable load on power plant design & operation – requirement of peak load plants – fixed or operating cost – load diversion – tariff methods for electrical energy – comparison of economic of different types of power plants – environmental hazards of various power plants.

TOTAL : 45 PERIODS**TEXT BOOKS**

1. M. N. El. WAKIL, Power Plant Technology, Mc Graw Hill, 1985.
2. ARCHIEW . CULP Jr., Principle of Energy Conversation, Mc Graw Hill.
3. P. K. NAG, Power Plant Engineering, TMG, 2008.3rd Edition.
4. G. R. NAGPAL, Power Plant Engineering, Khanna Publishers, 1986.

REFERENCES

- 1 VOPAL AND STORTZKI, Power Plant Engineering, PHI.
- 2 DOMKUNDWAR, Power Plant Engineering, Dhanpat Rai & Sons.2007, 5th Edition.
- 3 JOEL WEISMAN AND ROY ECKART, Morden Power Plant Engineering, PHI
- 4 G. D. RAI, Non Conventional Sources of Energy, Khanna Publishers, Delhi. 2007, 4th Edition.
- 5 V. Kadambi, An Introduction to Energy Conversion, New Age Publication Ltd, 2004.

PME4752**FLUID POWER SYSTEMS****L T P C****3 0 0 3****UNIT - I****9**

INTRODUCTION - Introduction to fluid power – review of fundamentals principles of fluid power – construction, operation and characteristics of gear pump, vane pump, variable displacement pump, piston pump. Fluid power actuators – linear and rotary – computation of force – flow requirements – cushioning – cylinder mountings – relatives merits – selection criteria for specific application – power pack design.

UNIT - II**9**

CONTROL SYSTEM COMPONENTS AND ACCESSORIES - Valves – non return valve for pressure control, direction control and flow control – servo valves and proportional control valves – valve actuation techniques – pressure, electrical, limit switch or sensor based. Relief valve- brake valve – counter balance valve. Fluid power maintenance – filter – seals- reservoirs. Selection of accumulator, hoses and couplings – safety regulation as per BIS.

UNIT - III**9**

HYDRAULIC CIRCUITS - Fluid power symbols, hydraulic circuit – regenerative – intensifier – metering out – bleed off. Design of circuits for specific applications – Vehicle suspension system – hydraulic press – low cost automation. Programmable logic control. Electrical control for fluid power circuits, Temperature control in Hydraulic circuits.

UNIT - IV**9**

HYDRAULIC CIRCUIT DESIGN - Design of circuits and selection of components with specification for the following applications – hydraulic or pneumatic system for shapers – lift hydraulic press – automatic reciprocating system – shock absorber – conveyor feed system – hydraulic cranes and earth moving equipment's.

UNIT - V**9**

PNEUMATIC SYSTEMS - Basic principles of pneumatic circuits – merits and demerits over hydraulic system, pneumatic conditioners – filters – regulators – lubricator – mufflers – air dryers. Types of air compressed – pneumatic actuators – control of pneumatic circuits – valves. Introduction to pneumatic logic controls- pneumo-hydraulic circuits.

TOTAL : 45 PERIODS**TEXTBOOKS**

1. ANTHONY ESPOSITO, Fluid Power with Applications, Prentice Hall, 1980
2. PIPPENGER, Industrial Hydraulics, TMH

REFERENCES

1. PRINCHES. M.J. & ASHBY JOHN, Power Hydraulics, Prentice Hall, 1989
2. SULLIIVAN JAMES .P, Fluid Power Theory and Application, Prentice Hall.

PME453**DESIGN OF MACHINE ELEMENTS****L T P C****3 1 0 4****UNIT - I****9**

Introduction to design process – factor influencing the machine design, selection of material based on its physical properties. Direct, bending and torsional stress equation, impact and shock loading. Criteria of failure, stress concentration factor, size factor, surface finish factor – factor of safety, design stress, theories of failures – simple problems.

UNIT - II**9**

Variable and cyclic loads – fatigue strength and limit, S-N curve, combined cyclic stress, Soderberg and Goodman's equations. Design of helical, leaf, disc, and torsional springs under constant loads and varying loads.

UNIT -III**9**

Design of solids and hollow shaft based on strength, rigidity and critical speed. Design and drawing of keys, keyways, coupling-rigid and flexible couplings.

UNIT - IV**9**

Design and drawings of welded joints, riveted joints for pressure vessels and structure. Threaded fasteners, cotter joint, knuckle joints, and pipe joints.

UNIT -V**9**

Design and drawing of piston, connecting rod, crank shaft and fly wheel

TOTAL : 45 PERIODS**TEXT BOOKS**

- 1 T.V. SUNDARAJAMOORTHY AND SHANMUGAM, Machine Design,
- 2 JOSEPH EDWARD SHIGHLEY, Mechanical Engineering Design, McGraw Hill. 2008, 8th Edition.
- 3 R.S. KHURMI & GUPTA JK, A text book of Machine Design, S. Chand & Co.,
- 4 PANDYA & SHAH, Elements of Machine Design,
- 5 DONALDSON. C, Tool Design, Tata McGraw Hill & Co.

REFERENCES

- 1 V. DOBROVOLSKY, Machine Elements, Mir Publication, 1978.
- 2 A.S. HALL, A.R. HOLOWENKO, AND H.G. LAUGHLIM, Theory And Problems In Machine Design Schaum's series
- 3 HALL AND ALLEN. S. Machine Design, Schaum's Series. 2008, TMH.
- 4 M.F. Spolts, Design of Machine Elements, Pearson Education, 2005, 7th Edition.
- 5 Gitin M. Maitra, Hand Book of Mechanical Design, 2nd Edition.
- 6 J. B. K Das, Design of Machine Elements, Sapna Book House, 2007, 2nd Edition.
- 7 A. S. Ravindra, Design of Machine Elements, Best Publishers, 2005. 2nd Edition.
- 8 V. B. Bhandari, Design of Machine Elements, TMH, 2007.

Hand book

Design data book, PSG College of technology, Coimbatore.

(Use of approved data books are permitted in all the examinations)

UNIT - I**9**

MECHATRONICS, SENSORS AND TRANSDUCERS -Introduction to Mechatronics Systems – Measurement Systems – Control Systems – Microprocessor based Controllers.

Sensors and Transducers – Performance Terminology – Sensors for Displacement, Position and Proximity; Velocity, Motion, Force, Fluid Pressure, Liquid Flow, Liquid Level, Temperature, Light Sensors – Selection of Sensors

UNIT - II**9**

ACTUATION SYSTEMS - Pneumatic and Hydraulic Systems – Directional Control Valves – Rotary Actuators. Mechanical Actuation Systems – Cams – Gear Trains – Ratchet and pawl – Belt and Chain Drives – Bearings.

Electrical Actuation Systems – Mechanical Switches – Solid State Switches – Solenoids – D.C Motors – A.C Motors – Stepper Motors.

UNIT - III**9**

SYSTEM MODELS AND CONTROLLERS - Building blocks of Mechanical, Electrical, Fluid and Thermal Systems, Rotational – Translational Systems, Electro-Mechanical Systems – Hydraulic – Mechanical Systems.

Continuous and discrete process Controllers – Control Mode – Two – Step mode – Proportional Mode – Derivative Mode – Integral Mode – PID Controllers – Digital Controllers – Velocity Control – Adaptive Control – Digital Logic Control – Micro Processors Control.

UNIT - IV**9**

PROGRAMMING LOGIC CONTROLLERS - Programmable Logic Controllers – Basic Structure – Memory - Input / Output Processing – Programming – Mnemonics – Timers, Internal relays and counters – Shift Registers – Master and Jump Controls – Data Handling – Analogs Input / Output – Selection of a PLC – PLC Applications

UNIT - V**9**

DESIGN OF MECHATRONICS SYSTEM - Stages in designing Mechatronics Systems – Traditional and Mechatronics Design - Possible Design Solutions

Case Studies of Mechatronics Systems, Pick and place robot – automatic Car Park Systems – Engine Management Systems Automatic Camera, Washing machine.

TOTAL : 45 PERIODS**TEXT BOOKS**

1. W. Bolton, “Mechatronics”, Pearson Education, 3rd Edition, 2007.

2. HMT Ltd, Mechatronics, TMH, 2007.

REFERENCES

1. Michael B. Histan and David G. Alciatore, "Introduction to Mechatronics and Measurement Systems", McGraw-Hill International Editions, 2007. 3rd Edition
2. Bradley D. A., Dawson D., Buru N.C. and Loader A.J, "Mechatronics", Chapman and Hall, 1993.
3. Dan Neculescu, "Mechatronics", Pearson Education Asia, 2002 (Indian Reprint).
4. Lawrence J. Kamm, "Understanding Electro – Mechanical Engineering", An Introduction to Mechatronics, Prentice – Hall of India Pvt., Ltd., 2000.
5. Nitaigour Premchand Mahadik, "Mechatronics", Tata McGraw-Hill publishing Company Ltd, 2003
6. Prof. C. R. Venkataramana, Mechatronics, Sapna Book House, 2003.

PME455

MECHATRONICS LABORATORY

L T P C

0 0 3 2

LIST OF EXPERIMENTS

1. Design and testing of fluid power circuits to control
(i) velocity (ii) direction and (iii) force of single and double acting actuators
2. Design of circuits with logic sequence using Electro pneumatic trainer kits.
3. Simulation of basic Hydraulic, Pneumatic and Electric circuits using software.
4. Circuits with multiple cylinder sequences in Electro pneumatic using PLC.
5. Servo controller interfacing for open loop
6. Servo controller interfacing for closed loop
7. PID controller interfacing
8. Stepper motor interfacing with 8051 Micro controller
(i) full step resolution (ii) half step resolution
9. Computerized data logging system with control for process variables like pressure flow and temperature.

TOTAL : 45 PERIODS

SEMESTER - VI

PME461

COMPUTER AIDED DESIGN

L T P C

3 0 0 3

UNIT – I

9

INTRODUCTION TO CAD - Introduction to Design process, Role of Computers in design, types of devices used in design (like display devices, digitizers, light pen, plotter, etc.) and their functions. Various CAD software.

UNIT – II

9

GRAPHICS CONCEPTS (2D & 3D) - Co-ordination System- Transformation, Translation, Scaling, Reflection, Rotation – Concatenated Transformation – Inverse Transformation, Projection – View, Orthographic, Isometric, perspective

UNIT – III

9

VISUALIZATION - windowing, View ports, clipping, Hidden line removal, hidden surface removal, Hidden Solid removal – shading-colouring-rendering-Animation.

UNIT - IV

9

MODELING - Geometric modeling- type- wireframe, Surface and solid Modeling. Solid Modeling Techniques- solid entities, Half-Spaces, Boundary Representation (B-Rep) – Constructive Solid Geometry (CSG) – Sweeps- solid Manipulation.

UNIT - V

9

GRAPHICS STANDARDS - Standards for computer graphics- Graphical Kernel System (GKS) - standards for exchange images- Open Graphics Library (OpenGL) - Data exchange standards - IGES, STEP, CALS etc. - communication standards.

TOTAL : 45 PERIODS

TEXTBOOKS

1. IBRAHIM ZEID, CAD/CAM, TMH, 2007.
2. NEWMAN AND SPROULL. R.F, Principles of Interactive Computer Graphics, McGraw Hill.
3. RADHAKRISHNAN. P, CAD/CAM/CIM, 3st ed. New Central Book Agency, 2008.
4. KANT VAJPAYEE, Principles of Computers – Integrated Manufacturing, 1st ed. PHI, 1995

REFERENCES

1. BESANT C.B & LUI.C.N.K, Computer Aided Design and Manufacture, 3rd ed. East West Press.

2. MIKELL P.GROOVER AND EMORY W.ZIMMERS.Jr., Computer Aided Design and Manufacturing, PHI. 2007.
3. PETER NINGHAM, CAD systems in Mechanical and Production Engineering, East West Press.
4. RAO, Features of AutoCad-2000, Wiley
5. SADHU SINGH, CAD/CAM, Khanna Publishers
6. Michael E. Mortenson, " Geometric Modeling ",John Wiley and sons,Inc,1997.
7. Rogers D.F., Adams J.A.,"Mathematical elements for computer graphics", McGraw Hill,1976.
8. Donald Hearn, M. Pauline Baker, "Computer graphics", Prentice Hall of India, New Delhi, 1997.

PME462

COMPUTER INTEGRATED MANUFACTURING

L T P C

3 0 0 3

UNIT - I

9

Introduction to Automation -Production system Facilities, Manufacturing Support Systems, Automation in Production Systems, Automated Manufacturing Systems, Types of Automation, Computerized manufacturing Support System, Reasons for Automating, Manufacturing Industries and Products, Manufacturing operations, Product / Production Relationships, Production Concepts and Mathematical Models. Basic elements of an Automated System, Advanced Automation Functions, Levels of Automation.

UNIT – II

9

Fundamentals of CAD, CAM and CAE, CIM Definition, CIM Wheel, CIM components, Evolution of CIM - Development of computers - Needs of CIM, Benefits of CIM. CIM Hardware & Software, CIM Models.

DBMS and Network system - Data base and DBMS- requirement, features and architecture of DBMS. CIM Communications (Network) System, Communication Matrix, Network Architectures, Tools and Techniques.

UNIT - III

9

Process Planning- Structure of a Process Planning, Process Planning function, CAPP - Types of CAPP, Retrieval and Generative type CAPP, Concurrent engineering, Design for Manufacturing and Assembly, Advanced Manufacturing Planning.

Group Technology – Introduction - coding and classification system, Production Flow Analysis, Coding System - OPTIZ, MICLASS, Benefits of Group Technology , Machine cell design.

UNIT – IV**9**

Fundamentals of NC Technology – Basic components of an NC System, NC Coordinate and Motion Control systems, Computer Numerical Control, Features of CNC, Machine Control Unit for CNC, CNC Software, DNC Machines, Application of NC machine tools Applications, Structure of CNC Machines, CNC Controllers, NC Part Programming, Computer-Assisted Part Programming.

Features and Applications of CNC Turning Centre, CNC Milling Machine, CNC Turn-Mill Centre, CNC machining Centre, CNC Tooling system and Automatic Tool Changing System, Computer Aided Quality Control - contact, non contact inspection methods, Coordinate Measuring Machine CMM - Integration of CAQC with CAD / CAM.

UNIT - V**9**

FMS -Components of FMS, Computer control and function, FMS planning, scheduling and control, Knowledge Based Scheduling, FMS operation control, Hierarchy of computer control, supervisory control, types of software used in FMS, Applications and Benefits. Shop floor control and its modules

Production Support Machines and Systems -Industrial Robots, Automated Material Handling, Automatic Guided Vehicles, Automated Storage and Retrieval system.

Developments in Manufacturing Technologies- AI and Expert System, Agile manufacturing, Lean Manufacturing, Virtual Manufacturing, Simulation in Manufacturing – Factories of Future.

TOTAL : 45 PERIODS**TEXT BOOKS**

1. KANT VAJPAYEE.S, Principles of Computer- Integrated Manufacturing; 1st ed. PHI 2006.
2. MIKELL P. GROOVER, Automation, Production Systems & CIM, 2nd ed. PHI 2001.
3. James A.Rehg, Henry W.Kraebber, Computer- Integrated Manufacturing, second Edition, Pearson Education.
4. P.N. Rao, CAD/CAM Principles and Applications Second Edition, TMH 2006.

REFERENCE BOOKS

1. Radhakrishnan.P, Subramanyan. S, Raju.V, 'CAD/CAM/CIM', Second Edition, New Age International publishers, 2000
2. Daniel Hunt.V., 'Computer Integrated Manufacturing Hand Book', Chapman & Hall, 1989
3. Groover M.P, 'Computer Aided Design and Manufacturing', Prentice Hall of India, 1987
4. Yorem Koren, 'Computer Control of Manufacturing System', McGraw Hill, 1986

5. Ranky Paul. G., 'Computer Integrated Manufacturing', Prentice Hall International, 1986.
6. ROGER MANNAM, Computer Integrated Manufacturing from Concepts of Realization 1st ed. Addison Wiley, 1997.
7. P. N. Rao, Computer Aided Manufacturing, TMH, 2007, 12th Edition.

PME463

DESIGN OF TRANSMISSION SYSTEMS

L T P C

3 1 0 4

UNIT – I

9

BEARINGS AND DRIVES - Design of sliding contact bearings using Sommerfield number – design using Mckee's equation, selection of rolling contact bearing for radial and axial load combination and for varying load cycles.

Design of flat belts and 'V' belts using manufacturer's data, introduction to continuously variable speed transmission, design of step cone pulley, design of chain drives, design of hoisting and hauling ropes.

UNIT- II

9

BRAKES, SCREWS AND CAMS - Design of clutches – Various service factors – dry and wet clutches, design of brakes - heat generation and dissipation in brakes – force analysis in drum brakes with external shoes – permissible bearing pressure – selection of brake material – braking power – power absorbed - bearing load calculations – width of shoe, design of band brakes – simple and differential type – width and thickness design. Introduction to design of disk brakes – brake lining fade.

Design of cams for parabolic, SHM, and cycloid follower motions, undercutting in cams – torque required to drive cams – polynomial motion cams – cam size determination – inertia force calculation – contact stress calculation.

UNIT - III

9

DESIGN OF SPUR AND HELICAL GEARS - Design of spur and helical gears – design of Geneva wheel mechanism, power rating calculations based on strength and wear considerations – gear tooth correction.

UNIT - IV

9

DESIGN OF POWER SCREWS - Design of power screws – wear and strength considerations – design of lead screws for machine tools, design of screw jacks and toggle jacks. Design of bevel and worm gears, design of Ratchet and Pawl mechanism

UNIT - V

9

MULTI SPEED GEAR BOXES - Design of speed reducers, design of multi speed gearboxes for Automobile - machine tools, structural and ray diagrams.

TOTAL : 45 PERIODS

TEXT BOOKS

1. PRABHU. T.J. Design of Transmission Elements.
2. SUNDARARAJAMURTHY.T.V AND SHANMUGAM, Machine Design, Khanna Publishers.
3. JOSEPH EDWARD SHIGHLEY, Mechanical Engineering Design, McGraw Hill. 2008, 8th Edition.
4. R.S. KHURMI & GUPTA JK, A text book of Machine Design, S. Chand & Co.,
5. PANDYA & SHAH, Elements of Machine Design,
6. DONALDSON. C, Tool Design, Tata McGraw Hill & Co.

REFERENCE BOOKS

1. V. DOBROVOLSKY, Machine Elements, Mir Publication, 1978.
2. SHIGLEY, Mechanical Engineering Design, McGraw Hill.
3. PANDYA AND SHAH, Elements of Machine Design.
4. MAITRA, Handbook of Gear Design, Tata McGraw Hill.
5. A.S. HALL, A.R. HOLOWENKO, AND H.G. LAUGHLIM, Theory And Problems In Machine Design Schaum's series
6. HALL AND ALLEN. S. Machine Design, Schaum's Series. 2008, TMH.
7. M.F. Spolts, Design of Machine Elements, Pearson Education, 2005, 7th Edition.
8. Gitin M. Maitra, Hand Book of Mechanical Design, 2nd Edition.
9. J. B. K Das, Design of Machine Elements, Sapna Book House, 2007, 2nd Edition.
10. A. S. Ravindra, Design of Machine Elements, Best Publishers, 2005. 2nd Edition.
11. V. B. Bhandari, Design of Machine Elements, TMH, 2007.
12. A.S.HOLOWENKO, A.R., AND LAUGHLIN H.G Theory and problems in Machine Design, Hall, Schaum series.

Hand book

Design data book, PSG College of technology, Coimbatore.

(Use of approved data books are permitted in all the examinations)

UNIT - I**9**

INTRODUCTION - Historical background – Matrix approach – Application to the continuum – Discretisation – Matrix algebra – Gaussian elimination – Governing equations for continuum – Classical Techniques in FEM – Weighted residual method – Ritz method

UNIT - II**9**

ONE DIMENSIONAL PROBLEMS - Finite element modeling – Coordinates and shape functions- Potential energy approach – Galarkin approach – Assembly of stiffness matrix and load vector – Finite element equations – Quadratic shape functions – Applications to plane trusses

UNIT - III**9**

TWO DIMENSIONAL CONTINUUM - Introduction – Finite element modelling – Scalar valued problem – Poisson equation – Laplace equation – Triangular elements – Element stiffness matrix – Force vector – Galarkin approach - Stress calculation – Temperature effects

UNIT - IV**9**

AXISYMMETRIC CONTINUUM - Axisymmetric formulation – Element stiffness matrix and force vector – Galarkin approach – Body forces and temperature effects – Stress calculations – Boundary conditions – Applications to cylinders under internal or external pressures – Rotating discs

UNIT - V**9**

ISOPARAMETRIC ELEMENTS FOR TWO DIMENSIONAL CONTINUUM - The four node quadrilateral – Shape functions – Element stiffness matrix and force vector – Numerical integration - Stiffness integration – Stress calculations – Four node quadrilateral for axisymmetric problems.

TOTAL : 45 PERIODS**TEXT BOOKS**

- 1 Chandrupatla T.R., and Belegundu A.D., “Introduction to Finite Elements in Engineering”, Pearson Education 2002, 3rd Edition.
- 2 David V Hutton “Fundamentals of Finite Element Analysis”2004. McGraw-Hill Int. Ed.
- 3 Rao S.S., “The Finite Element Method in Engineering”, Pergammon Press, 1989

REFERENCES

- 1 Logan D.L., "A First course in the Finite Element Method", Third Edition, Thomson Learning, 2002.
- 2 Robert D.Cook., David.S, Malkucs Michael E Plesha, "Concepts and Applications of Finite Element Analysis" 4 Ed. Wiley, 2003.
- 3 Reddy J.N., "An Introduction to Finite Element Method", McGraw-Hill International Student Edition, 1985
- 4 O.C.Zienkiewicz and R.L.Taylor, "The Finite Element Methods, Vol.1", "The basic formulation and linear problems, Vol.1", Butterworth Heineman, 5th Edition, 2000.
- 5 C. S. Krishnamoorthy, Finite Element Analysis, TMH, 2007, 2nd Edition.
- 6 K. J. Bathe, Finite Element Procedures, PHI, 2006,
- 7 Desai/ Abel, Introduction to Finite Element Method, CBS Publishers, 2005.
- 8 S. M. Murigendrappa, Fundamental of Finite Element Method, Interline Publishing, 2006.

PME465

CAD / CAM LABORATORY

L T P C

0 0 3 2

OBJECTIVES:

- To gain practical experience in handling 2D drafting and 3D modelling software systems.
- To study the features of CNC Machine Tool.
- To expose students to modern control systems (Fanuc, Siemens etc.,)
- To know the application of various CNC machines like CNC lathe, CNC Vertical Machining centre, CNC EDM and CNC wire-cut and studying of Rapid prototyping.

1. 3D GEOMETRIC MODELLING

24 PERIODS

LIST OF EXPERIMENTS

- 1 Introduction of 3D Modelling software

Creation of 3D assembly model of following machine elements using 3D Modelling software

- 2 Flange Coupling
- 3 Plummer Block
- 4 Screw Jack
- 5 Lathe Tailstock
- 6 Universal Joint
- 7 Machine Vice
- 8 Connecting rod
- 9 Piston
- 10Crankshaft

2. MANUAL PART PROGRAMMING.

21 PERIODS

- (i) Part Programming - CNC Machining Centre
 - a. Linear Cutting.
 - b. Circular cutting.
 - c. Cutter Radius Compensation.
 - d. Canned Cycle Operations.

(ii) Part Programming - CNC Turning Centre

- a. Straight, Taper and Radius Turning.
- b. Thread Cutting.
- c. Rough and Finish Turning Cycle.
- d. Drilling and Tapping Cycle.

3. COMPUTER AIDED PART PROGRAMMING

- a. CL Data and Post process generation using CAM packages.
- b. Application of CAPP in Machining and Turning Centre.

4. SIMULATION AND NC CODE GENERATION

NC code generation using CAD / CAM softwares - Post processing for standard CNC Controls like FANUC, Hiedenhain etc.

Note: Any one of the CAM softwares like EdgeCAM, MasterCAM, EspiritCAM, can be used for practicing the above

TOTAL: 45 PERIODS

SEMESTER - VII

PME471	PRINCIPLES OF INDUSTRIAL MANAGEMENT	L T P C
		3 0 0 3

UNIT - I

9

MANAGEMENT AND ITS ENVIRONMENT - Management – definition – functions, evolution of modern management, scientific management movement, development of management thoughts, different schools of management, forms of organization – individual ownership – partnership – companies – public sector undertakings, corporate framework – share holders – board of directors – committees – chief executive – line and functional managers, constraints – environmental – financial – legal – trade unions – technology - cooperative enterprises.

UNIT - II

9

MANAGEMENT OF ORGANISATION - Planning – nature and purpose – objectives – strategies – policies and planing premises – decision making, Organising - nature and process – premises – departmentalization – line and staff – decentralisation – organisational culture, Staffing – selection and training – placement – performance appraisal – career strategy, Leading – managing human factor – motivation, leadership – communication, Controlling – system and process of controlling – controlling techniques.

UNIT - III

9

Industrial Behavior - Organisational behavior – definition – managerial role and functions – organisational approaches, individual behavior – causes – environmental effect – behavior and performance, perception – organisational implications, personality – contributing factors – dimension - motivation – need theories – process theories – job satisfaction, learning and behavior – learning curves, work design and approaches.

UNIT - IV

9

GROUP BEHAVIOR - Groups – contributing factors – group norms, communication – process – barriers to communication – effective communication, managerial grid – leadership styles – group decision making – leadership role in group decision, group conflict.

Formal and informal – organisational structures, organisational change and development – change process – resistance to change – O.D. programme – culture and ethics.

UNIT - V**9**

MODERN MANAGEMENT CONCEPTS - Management by objectives (MBO) – Principles and steps – advantages and disadvantages, management by exception (MBE), strategic management, planning for future direction – SWOT analysis – evolving development strategies, information technology in management – decision support systems –electronic commerce/business, newer concepts – business process reengineering (BPR) - enterprise resource planning (ERP) – supply chain management (SCM) – activity based management (ABM).

TOTAL: 45 PERIODS**TEXTBOOKS**

1. HARROLD KOONTZ AND HEINZ WEIHRICH, Essentials Of Management, Mc Graw Hill

REFERENCES

1. Jit. S. CHANDRAN, Organisational Behaviors, Vikas publishing House Pvt. Ltd., New Delhi
2. ERNEST DALE, Management Theory And Practice, International edition, Mc Graw Hill.

PME472**TOTAL QUALITY MANAGEMENT****L T P C****3 0 0 3****UNIT - I****9**

INTRODUCTION - Definition of Quality, Dimensions of Quality, Quality Planning, Quality costs - Analysis Techniques for Quality Costs, Basic concepts of Total Quality Management, Historical Review, Principles of TQM, Leadership – Concepts, Role of Senior Management, Quality Council, Quality Statements, Strategic Planning, Deming Philosophy, Barriers to TQM Implementation.

UNIT - II**9**

TQM PRINCIPLES - Customer satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement – Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits, Continuous Process Improvement – Juran Trilogy, PDSA Cycle, 5S, Kaizen, Supplier Partnership – Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures – Basic Concepts, Strategy, Performance Measure.

UNIT - III**9**

TQM TOOLS - Benchmarking – Reasons to Benchmark, Benchmarking Process, Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM) – Concept, Improvement Needs, FMEA – Stages of FMEA.

UNIT- IV**9**

QUALITY SYSTEMS - Quality Auditing - Need for ISO 9000 and Other Quality Systems, ISO 9000:2000 Quality System – Elements, Implementation of Quality System, Documentation, TS 16949, ISO 14000 – Concept, Requirements and Benefits.

UNIT - V**9**

STATISTICAL PROCESS CONTROL (SPC) - The seven tools of quality, Statistical Fundamentals – Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables and attributes, Process capability, Concept of six sigma, New seven Management tools.

TOTAL: 45 PERIODS**TEXT BOOK**

1. Dale H.Besterfield, et al., “Total Quality Management”, Pearson Education, Inc. 2003. (Indian reprint 2004). ISBN 81-297-0260-6.

REFERENCES

1. James R.Evans & William M.Lindsay, “The Management and Control of Quality”, (5th Edition), South-Western (Thomson Learning), 2002 (ISBN 0-324-06680-5).
2. Oakland.J.S. “Total Quality Management”, Butterworth – Heinemann Ltd., Oxford. 1989.
3. Narayana V. and Sreenivasan, N.S. “Quality Management – Concepts and Tasks”, New Age International 1996.
4. Zeiri. “Total Quality Management for Engineers”, Wood Head Publishers, 1991.

- Identification of a real life problem in thrust areas
- Finalisation of system requirements and specification
- Proposing different solutions for the problem based on literature survey
- Implementation
- Testing & Validation of the developed system
- Learning in the Project
- Submission of Consolidated final project report
- Presentation of the above work

TEXT BOOK:

1. Energy Manager Training Manual(4 Volumes) available at www.energymanagertraining.com, a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India.2004.

REFERENCES:

- 1 L.C. Witte, P.S. Schmidt, D.R. Brown, "Industrial Energy Management and Utilisation" HemispherePubl, Washington, 1988.
- 2 Callaghn, P.W. "Design and Management for Energy Conservation", Pergamon Press, Oxford, 1981.
- 3 I.G.C. Dryden, "The Efficient Use of Energy" Butterworths, London, 1982
- 4 W.C. turner, "Energy Management Hand book" Wiley, New York, 1982.
- 5 W.R. Murphy and G. Mc KAY "Energy Management" Butterworths, London 1987.

PME473B PLANT LAYOUT AND MATERIAL HANDLING L T P C
3 0 0 3

UNIT -I**9**

PLANT LOCATION & PHYSICAL FACILITIES - Introduction - Factors to be considered - Selection of plant site -Consideration in facilities planning and layout – Installation and implementation of layout

Equipment required for plant operation - Classification of equipment - Main factors for selection of equipment - Capacity Integration of equipment and capacity – Serviceability – Flexibility - Analysis in selection of equipment - Space requirements - Man Power Requirements.

UNIT- II**9**

PLANT LAYOUT - Introduction - Need for Layout – Factors influencing Plant Layout – Product or Line Layout - Process or Functional Layout – Fixed Position Layout – Combination Layout – Tools and Techniques for developing Layout – Process Chart – Flow Diagram – String Diagram – Template – Scale models – Layout Planning Procedure – Visualization of Layout – Revision and improving existing Layout - Line balancing – Fabrication line balancing – Assembly Line balancing.

UNIT -III**9**

MATERIAL HANDLING - Introduction – Importance – Scope – Principles of Material handling – Planning Principle – Operation Principle – Equipment Principle – Costing Principle – Types of Material Handling System – Factors Influencing the Selection of Material Handling Devices – Common Material Handling Devices in use – Specification of material handling equipment

UNIT - IV**9**

ANALYSIS OF MATERIAL HANDLING & PACKAGING - Factors involved – Motion Analysis – Safety Analysis – Need for Safety – Equipment – Cost analysis – Palletization Analysis – Analysis of operation – Material Handling Surveys – Need for Survey – Types of Surveys - Reasons for Bad Material Handling.
Packing of Material – Importance of Packaging – Layout of Packaging – Package Machineries – Types – Wrapping and Packing of Materials – Cushion Materials.

UNIT -V**9**

MATERIAL HANDLING SYSTEM - Flexible hoisting appliances like ropes and chains- welded load chains- roller chains- selection of chains hemp rope and steel wire rope- selection of ropes- fastening of chains and ropes- different types of load suspension appliances- fixed and movable pulleys- different types of pulley systems- multiple pulley systems- chain and rope sheaves and sprockets

TOTAL : 45 PERIODS**TEXT BOOK**

1. James M Apple “Plant Layout And Material Handling” John Willey & Sons, New york, Third Edition, 1983.

REFERENCE

1. Mikell .p. Groover “Automation Production System and Computer Integrated Manufacturing”, Prentice Hall of India Pvt. Ltd, First edition, 1987
2. Govindan K.R. “Plant Layout And Material Handling”, Anuradha Agencies, First Edition, 1997

OBJECTIVE:

- The objective of the course is to impart knowledge on Design of Gating system for castings, Foundry Practice of Ferrous, Non Ferrous alloys, Foundry Mechanisation Welding Processes and Welding Metallurgy.

UNIT I DESIGN OF GATING SYSTEM**11**

Gating System design pouring Time – Choke Area – Sprue – Other gating elements – Riser design - Caines – modulus – Naval research Laboratory method – feeding distances – Chills feeding Aids – design of Castings.

UNIT II FERROUS AND NON FERROUS CASTINGS**10**

Steel Casting – The family of cast iron – melting of steels and cast irons – Grey iron foundry practice – Ductile iron – Malleable Iron casting design – Considerations Aluminium, Magnesium, Copper, Zinc, Duplex Stainless Steel and Titanium alloys foundry practice.

UNIT III FOUNDRY MECHANISATION**8**

Mechanical equipments in foundry – plant site location, layout – Plant Engineering – Maintenance – Services – Practical aspects.

UNIT IV WELDING PROCESS AND TECHNOLOGY**8**

Friction Welding Process – effect of speed and pressure – explosive welding – plasma arc welding – Electron beam welding – High frequency induction welding - Laser beam welding.

UNIT V WELDING METALLURGY**8**

Weld thermal cycles – Heat Affected Zone(HAZ) – Weldability of steels – Cast Iron – Stainless steel, aluminium – Copper and Titanium alloys – Hydrogen embrittlement – Pre and post weld heat Treatments – weld defects – Testing of Welds.

TOTAL : 45 PERIODS**TEXT BOOK:**

- P.N.Rao, Manufacturing Technology, Tata McGraw Hill, 2008.

REFERENCES:

- Heine, Loper and Rosenthal, Principles of Metal Casting, Tata McGraw Hill, 2001
- A.K.Chakrabarti, Casting Technology and Cast Alloys, Prentice –Hall Of India Ltd, 2005
- T.V.Rama Rao, Metal casting Principles and Practice, New Age International, 2010
- R.S Parmar, Welding Engineering and Technology, Khanna Pub.

UNIT - I**9**

PRINCIPLES OF LOCATION AND CLAMPING - Locating and clamping methods and devices. Objectives of Jigs design – principles of Jig. Types of drill and their design – Module design – chip control, drill bushings.

UNIT – II**9**

FIXTURES - Objectives of Fixture design – Fixtures and economics, Types of Fixtures, Grinding Fixtures, Milling Fixtures, Shaping Fixtures, Welding Fixtures, and Assembly Fixture. Clamping force calculations, errors in location and clamping, Design and drawing.

UNIT - III**9**

SHEET METAL - Power press types – Press specification, material handling, Equipment cutting action in punch and Die operations, die clearance, cutting forces in blanking, Piercing and shearing, punch and die mounting, stripping force, press tonnage.

UNIT - IV**9**

Pilot, Stripper, Pressure pad and automatic stop – Strip layout and material calculations. Selection of Die sets – Designing of simple, progressive and compound die sets.

UNIT - V**9**

FORMING DIE DESIGN - Bending methods, bend radius, bend allowance, spring back, bending pressure. Design of bending die, metal flow in drawing, single and double action die, development of blank reduction factor, drawing forces, blank diameter calculation, Design of drawing die. Principles of forging and extrusion dies. Defects and remedies.

TOTAL : 45 PERIODS**TEXT BOOKS**

1. DONALDSON. C, Tool Design, Tata McGraw Hill Co Ltd.
2. HOFFMAN. G, Fundamentals of Tool Design, SMF Publishers.

REFERENCES

1. KEMPSTER, Introduction to tool design and jigs and fixtures.
2. KORASAKOW, Fundamentals of Jigs and Fixtures, MIR Pub.
3. JOSHI. P.H. Jigs and Fixtures, Tata McGraw Hill Co Ltd.
4. Hiram E. Grant, Jigs and Fixtures, TMH, 2006.

UNIT - I**9**

BASIC CONCEPT OF TURBO MACHINES- Definition and classification of turbo machines, specific work, T-S and H-S diagram, equation of energy transfer. Losses – Total-to-total efficiency, total to static efficiency, infinitesimal stage efficiency, effect of reheat, preheat.

Aero-foil section, cascading of compressor and turbine blades, energy transfer in terms of lift and drag coefficient for compressor and turbine blades, variation of lift, deflection and stagnation pressure loss with incidence.

UNIT - II**9**

CENTRIFUGAL FANS, BLOWERS - Construction details, induced, backward and radial blades, diffuser, volute casing stage work, stage pressure rise, stage pressure coefficient, stage efficiency, degree of reaction, various slip factors

AXIAL FLOW FANS: stage velocity triangles, blade loading and flow coefficient, static pressure rise H-S diagram, degree of reaction, work done factor, Free and forced vortex, performance

UNIT – III**9**

CENTRIFUGAL COMPRESSOR - Construction – Stage velocity triangles h-s diagram – Slip factor – Diffuser – Volute casing – Stage losses – performance characteristics.

UNIT - IV**9**

AXIAL TURBINE - Stage velocity triangle, work, single impulse turbine, speed ratio, maximum utilization factor, multistage, velocity compound impulse, multistage pressure, compound impulse, degree of reaction, zero reaction stages, fifty percent reaction stages, hundred percent reaction, negative reaction, free and forced vortex flow.

Inward flow radial turbine stage, 90 degree IFR turbine H-S diagram, degree of reaction, steam turbine governing

UNIT - V**9**

INTRODUCTION TO CFD - One-Dimensional computations by finite difference methods, Finite element methods, finite volume methods, Neumann boundary conditions, Dirichlet boundary conditions, Governing equations, Navier stokes system of equations. Finite differences, discretization, consistency, stability. Fundamentals of fluid flow modeling. Finite difference applications an heat conduction and convection.

TOTAL : 45 PERIODS

TEXTBOOKS

- 1 S.M YAHYA, Turbine, Fans and Compressor, TMH.
- 2 S.M YAHYA, Fundamentals of Compressible flow with Aircraft and Rocket Propulsion, New Age International, 1996
- 3 GANESAN. V, Gas Turbines, TMH, 1999
- 4 T. J. CHUNG, Computational Fluid Dynamics, Cambridge University Press, 2003.

REFERENCES

- 1 ASCHER .H. SHAPORO, The Dynamics and Thermodynamics of Compressible Flow VOL I and VOLII The Ronald Press. Co, NY 1995.
- 2 JHON D.ANDERSON Jr. Introduction to Flight, III Edition, Mc – Graw Hill ISE 1989.
- 3 ALAN J. CHAPMAN, WILLIAM.F.WALKER, HOLT, Introduction to gas dynamics, Rinehart and winston, 1971
- 4 DR.SL. SOMASUNDRAM, Gas dynamics and jet propulsion.
- 5 A.H.CHURCH ND.JAGDISH LAL, Centrifugal Pumps and Blower, Metropolitan Book Co. PVT Ltd.
- 6 HILL D. PETERSON C. Mechanics & Thermodynamics of Propulsions, Addison Wiley, 1999
- 7 SULTON GP. Rocket Propulsion elements, John Wiley, New York, 1986
- 8 COHEN H. REC ROGERS & SRAVANAMUTOO, Gas Turbine Theory, Addison Wiley, 1987
- 9 GOPALAKRISHNAN G. & PRITHVIRAJ D, Treatise on Turbo machines, Jupiter Publications, 2000
- 10 DAVID M. EGGLESTON and FOREST S. STODDARD, Wind Turbine Engineering Design, Van Nostrand, 1987
- 11 SHEPERD DG. Theory of Turbo machines, McMillan, 1969
- 12 KADHAMBHI V. MANOHAR PRASAD, Introduction to Energy Conversions, Vol – III, Turbo machines, Wiley Eastern, 1997

PME473F

TOTAL PRODUCTIVE MAINTENANCE

L T P C

3 0 0 3

OBJECTIVE:

- To teach the students basic concepts of Total Productive Maintenance. Expose the students to the objectives, maintenance models, group activities, logistics, condition monitoring and implementation of Total Productive Maintenance.

UNIT I MAINTENANCE CONCEPTS

9

Introduction - Objectives and functions – Productivity, Quality, Reliability and Maintainability

(PQRM) - Terotechnology – Reliability Centered Maintenance - Predictive

Maintenance

- Condition Based Maintenance – maintainability prediction – availability and system effectiveness- maintenance costs – maintenance organization.

UNIT II MAINTENANCE MODELS 9

Minimal repair – As Good As New policy – maintenance types – balancing PM and breakdown maintenance- PM schedules: deviations on both sides of target values – PM schedules: functional characteristics – replacement models.

UNIT III TOTAL PRODUCTIVE MAINTENANCE 9

Zero breakdowns – Zero Defects and TPM – maximizing equipment effectiveness – Autonomous maintenance program – five pillars of TPM – TPM small group activities

– TPM organization – Management Decision – Educational campaign – Creation of Organizations – Establishment of basic policies and goals – Formation of master plan - TPM implementation.

UNIT IV MAINTENANCE LOGISTICS 9

Human factors in maintenance – maintenance manuals – maintenance staffing methods – queuing applications – simulation – spare parts management – maintenance planning and scheduling.

UNIT V ONLINE MONITORING 9

Condition monitoring - Infrared Thermography, Oil Analysis, acoustic emissions testing, Motor Current Analysis, Vibration Measurement and Analysis, Wear Debris Monitoring, Visual checks - corrosion control - Maintenance Management Information System - Expert system applications.

TOTAL: 45 PERIODS

TEXT BOOKS :

1. Nakajima S., "Introduction to TPM", Productivity Press, Chennai, 1992.
2. Srivastava S.K., "Maintenance Engineering (Pri.Practices & Management)", S. Chand Group, 2011.

REFERENCES :

1. Wireman T., "Total Productive Maintenance", Industrial Press Inc., New york, 2004
2. Goto F., "Equipment planning for TPM Maintenance Prevention Design", Productivity Press, 1992.
3. Shirose K., "Total Productive Maintenance for Workshop Leaders", Productivity Press, 1992.

4. Shirose K., "TPM for Operators", Productivity Press, 1996.
5. Suzuki T., "New Directions for TPM", Productivity Press, 1993.
6. Kelly A., "Maintenance planning and control", Butterworths, London, 1991.

PME473G

GAS DYNAMICS & JET PROPULSION

L T P C

3 1 0 3

UNIT - I

9

BASIC CONCEPTS AND ISENTROPIC FLOWS - Energy and momentum equations of compressible fluid flows - Stagnation states, Mach waves and Mach cone - Effect of Mach number on compressibility - Isentropic flow through variable area ducts - Nozzle and Diffusers - Use of Gas tables.

UNIT - II

9

FLOW THROUGH DUCTS - Flow through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) - Variation of flow properties - Use of tables and charts - Generalised gas dynamics.

UNIT - III

9

NORMAL AND OBLIQUE SHOCKS - Governing equations - Variation of flow parameters across the normal and oblique shocks - Prandtl - Meyer relations - Use of table and charts - Applications.

UNIT - IV

9

JET PROPULSION - Theory of jet propulsion - Thrust equation - Thrust power and propulsive efficiency - Operation principle, cycle analysis and use of stagnation state performance of ram jet, turbojet, turbofan & turbo prop engines – Aircraft combustors

UNIT - V

9

SPACE PROPULSION - Types of rocket engines - Propellants - Ignition and combustion - Theory of rocket propulsion - Performance study - Staging - Terminal and characteristic velocity - Applications - Space flights.

TOTAL : 45 PERIODS

TEXT BOOK

1. S.M. Yahya, " Fundamentals of Compressible Flow ", New Age International (P)Limited, New Delhi, 2007.

REFERENCES

1. P.Hill and C. Peterson, " Mechanics and Thermodynamics of Propulsion, Addison Wesley Publishing Company, 1992.

2. N.J. Zucrow, " Aircraft and Missile Propulsion, Vol. I & II ", John Wiley , 1975.
3. N.J. Zucrow, " Principles of Jet Propulsion and Gas Turbines ", John Wiley, New York, 1970.
4. H.Cohen, G.E.C.Rogers and Saravanamuttoo, " Gas Turbine Theory Longman Group Ltd., 1980.
5. G.P.Sutton, " Rocket Propulsion Elements ", John Wiley, 1986,New York.
6. V.Ganesan, " Gas Turbines ", Tata McGraw Hill Publishing Co., New Delhi, 2008. 2nd Edition.
7. E. Radhakrishnan, Gas Dynamics, PHI, 2000. 2nd Edition.

PME473H

VIBRATION AND NOISE CONTROL

L T P C

3 0 0 3

UNIT I

9

SINGLE AND TWO DEGREES OF FREEDOM VIBRATION - Review of single degree of freedom systems – free damped vibration – linear and torsion vibrations, seismometer, accelerometer. Two degrees of freedom – vibration absorbers – undamped and damped, vibration isolation.

UNIT II

9

MULTI DEGREE FREEDOM VIBRATIONS - Multi degree vibration system – free vibration – close coupled and far coupled systems, eigen value problems, Orthogonality of mode shapes, modal analysis, forced vibration modal analysis, numerical methods – dunkerley, Raleigh and Holzer methods.

UNIT III

9

BALANCING - Rotor balancing methods – rigid & flexible rotor balancing, modal balancing – analytical developments – application to balancing, advantage and limitations of modal balancing, influence coefficient balancing, analytical developments balancing – procedure – advantages and limitations. Unified balancing approach – analytical development- balancing procedure – experimental comparison of various methods.

UNIT IV

9

VIBRATION MONITORING - Experimental methods in vibration analysis – vibration exciters measurements devices, analyzer, condition based maintenance of monitoring and analysis – case studies.

UNIT V**9**

NOISE CONTROL -Sound wave characteristic – levels and decibels – directivity, source of noise, estimation of noise source, acoustics of walls – enclosures barriers, sound absorbing materials duct noise, mufflers.

TOTAL : 45 PERIODS**TEXT BOOKS**

- 1 RAO J.S AND GUPTA K, Theory and Practice of Mechanical, John Wiley
- 2 TIMSOHENKO, S. YOUNG D.H & WEAVER W, Vibration Problems in Engineering 4th ed. John Wiley & Sons, 1967.
- 3 KEWAL K. RUJARA, Vibrations and Noise for Engineering, Dhanpat Rai & Sons.

REFERENCE BOOKS

1. ASHOK KUMAR MALLIK, Principle of Vibration Control, Affiliated East West Press, 1993
2. GROVER. G.K, Mechanical Vibration, New Chand Bros., Roorkee (UP), 1989.
3. MARK S, DARLOW, Balancing of High Speed Machinery, Springer Verlag

PME473I**REFRIGERATION AND AIR CONDITIONING****L T P C****3 0 0 3****UNIT I****9**

Review of thermodynamics, principle of refrigeration, refrigeration cycle: air cycle system, Bell – Coleman cycle system. VAPOUR COMPRESSION REFRIGERATION: Analysis of Vapour compression refrigeration, uses of P.H charts, performance test, Vapour absorption refrigeration, absorption cycle, Claude system, cascade system, comparison of performance & COP.

UNIT II**9**

Compressor – reciprocating, rotary (elementary treatment). Condenser – evaporator – cooling tower. Refrigerant- properties – selection of refrigerants, refrigeration plant operation and controls - testing and charging of refrigeration units.

APPLICATION: Ice plant, food storage plants, milk chilling plant, refrigeration cargo ships, cryogenic in medicine & biological uses.

UNIT III**9**

Review of fundamental properties of psychrometry use of psychrometric charts, psychrometric processes, grand and room sensible heat factor, by pass factor, requirements of comfort air conditioning, comfort and comfort chart, factor governing optimum effective temperature recommended design conditions, ventilation standards.

UNIT IV

9

Cooling load calculations, types of load design, space cooling load, heat transmission through building, solar cooling & heating, solar radiation, infiltration heat source (sensible & latent) Outside air & fresh air load, estimation of total load, design of air conditioning system.

UNIT V

9

AIR CONDITONING SYSTEMS: Commercial & industry stores and public building A/C, ventilation, air conditioning equipment, air cleaning and air filters, humidifiers, dehumidifiers- air washer, condenser, cooling tower and spray pounds, elementary treatment of duct design, air distribution system.

TOTAL : 45 PERIODS**TEXTBOOKS**

1. ARORA C.P, Refrigeration and Air Conditioning, TMH, New Delhi, 1988.
2. P.L BALLANY, Refrigeration and Air conditioning

REFERENCES

1. ARORA S.C AND DOMKUNDWAR S, Refrigeration & Air Conditioning, Dhanpat Rai and Sons Publishers, 1990
2. MANOHAR PRASAD, Refrigeration and Air Conditioning, Wiley Eastern Ltd, 1983
3. ROY J. DOSSAT, Principles of Refrigeration, SI version, Wiley Eastern Ltd, 1985
4. STOEKER, Refrigeration & Air Conditioning, McGraw Hill

PME473J**COMPUTATIONAL FLUID DYNAMICS****L T P C
3 0 0 3****UNIT I**

9

Introduction to CFD Form of mass, energy and momentum equations, description of terms; boundary conditions and simple solution examples.

UNIT II

9

Static Features of CFD code: FLUENT Modeling for steady incompressible flow, pressure drop and heat transfer.

UNIT III

9

Solution Methods Solution algorithms, discretisation schemes, solution convergence, divergence and residuals.

UNIT IV**9**

Model Formulation Geometry and grid design, boundary conditions of the domain, choice of physical models for turbulence and heat transfer, modeling of fluid properties.

UNIT V**9**

Case Study Examples modeling pressure drop and heat transfer in a range of engineering examples.

TOTAL : 45 PERIODS**TEXTBOOKS**

- 1 FLETCHER, C.A.J, Computational Techniques for Fluid Mechanics, Springer-Verlag, 1991
- 2 SHAW, C.T, Using Computational Fluid Dynamics, Prentice Hall, 1992

REFERENCES

- 1 J.D.ANDERSON, Computational Fluid Dynamics.
- 2 NK BOSE, Computer Numerical Methods for Fluid Mechanics.

PME473K**NANO TECHNOLOGY****L T P C****3 0 0 3****UNIT I****9**

INTRODUCTION TO PHYSICS OF SOLID STATE - Intermolecular forces: thermodynamic aspects - Quantum Mechanical Treatment of the Many-Particle Problem - Potential Energy Surface - Pair Potential Approximation - Advantages and Limitations of the Pair Potential Approximation - Phenomenological Potentials - Pseudo-Potentials - Many-Body Potentials.

UNIT II**9**

FUNDAMENTALS OF NANOSCIENCE - Size dependence of properties - Particle size determination - Bulk to nano transition - Semiconducting nanoparticles - Carbon nanostructures - Mechanical properties (hardness, ductility, elasticity) - Optical properties of nanotubes - Electrical properties of nanotubes.

UNIT III**9**

PREPARATION OF NANOSYSTEMS - Introduction to nanolithography - Carbon nanotubes: preparation - Synthesis and preparation of nanomaterials (crystalline and thinfilm) - Physical and chemical methods - Control and stability (size, shape, composition).

UNIT IV**9**

CHARACTERIZATION OF NANOSYSTEMS - Thermal Stability - Basic Material Properties - Mean Mean Values and Correlation Functions - X-ray diffraction - Scanning Electron Microscopy - Scanning Tunneling Microscopy - Electron Microscopy - X-ray absorption spectroscopy – Photoelectron emission spectroscopy.

UNIT V**9**

NANO-ENGINEERING: APPLICATIONS - Nanotubes, nanowires, and nanodevices-introduction - Functional Nanostructures – Introduction to molecular electronics - Field emission and Shielding - Applications in Computers - Applications in fuel cells - Applications in chemical sensors - Applications in mechanical reinforcement - Microelectromechanical systems (MEMs) - Nanoelectromechanical systems (NEMs) - Molecular and Supramolecular Switches.

TOTAL : 45 PERIODS**TEXT BOOKS****UNIT I AND II**

- 1 Charles P. Poole and Frank J Owens. *Introduction to nanotechnology*.
- 2 Wiley Interscience, 2003.
- 3 Crandall, B. C. and Lewis, James (Eds.) *“Nanotechnology: Research and Perspectives”* MIT Press, 1992.

UNIT III AND IV

- 1 P E J Flewitt, R K Wild. *Physical Methods for Materials Characterization. 2nd Edition*, Institute of Physics Publishing, UK. 2004.
- 2 Gottstein, Günter. (2004) *Physical Foundations of Material Science*. Springer Verlag.
- 3 UNIT V
- 4 Cleland, Andrew N. (2003). *Foundations of Nanomechanics: From Solid-State Theory to Device Applications*. Springer Verlag.

REFERENCES

- 1 J M Vail, Winnipeg. *Topics in the Theory of Solid Materials*. Institute of Physics Publishing, UK. 2004.
- 2 M W Barsoum. *Fundamentals of Ceramics*. Institute of Physics Publishing, UK. 2004.
- 3 A S Edelstein, R C Cammarata, *Nanomaterials: Synthesis, Properties and Applications*. IOP Publishing, UK, 1998.
- 4 Bhushan, Bharat (Ed.) (2004) *Springer Handbook of Nanotechnology*

UNIT I**9**

WORK STUDY AND PRODUCTIVITY - Need, Aim and Scope of Work Study, Techniques of Work Study and their relationship, Basic Procedure of Work Study, Productivity and the Standard of Living, Productivity in the individual enterprise, Management techniques to reduce work content and ineffective time, Human Factors in the application of Work Study. Job Evaluation, Merit Rating and Wage Incentive Plans.

UNIT II**9**

METHOD STUDY - Introduction, Basic Procedure, Factors involved in Selection of Jobs, Recording Techniques – Charts and Diagrams, Questioning Techniques, Developing improved method.

Principles of Motion Economy, Therbligs, Two Handed process chart, Micromotion and Macromotion Study, SIMO Chart, Design of Work Place Layout, types of Plant Layout, Flow Diagram, String Diagram, Use of Templates and Scale Models, Multiple Activity Chart, Travel Chart.

UNIT III**9**

WORK MEASUREMENT -General remarks on Work Measurement, Time Study equipment, Selecting the Job to be studied and making a Time Study, Rating Factors Involved, Allowances to Standard Time, setting Time Standards for Work.

Other Techniques of Work Measurement – Production Study, Activity Sampling, Synthesis – Synthesized Time Standards, Analytical Estimating, Predetermined Motion Time Systems, MTM, Work Factor, Standard Data and its uses.

UNIT IV**9**

HUMAN FACTORS IN WORK DESIGN - Ergonomics, work Physiology, human performance, anthropometry, Design of Work Station, Design of Displays and Control. Fatigue and its effects.

Organization of Work Study Department – Place of Work Study Department in the Organization, Structure of Work Study Department, Selection and Training of Work Study Personnel.

UNIT V**9**

COST ESTIMATION - Introduction, Definition, Purpose of Cost Estimation, Cost Estimation Vs Cost Accounting, Components of Cost, Direct Cost, Indirect Cost, Overhead Expenses, Estimation of cost elements, set up, operation, tool change and inspection costs, performance factors, Overheads, different methods of apportioning overheads, Data required for Cost Estimating, Steps in making a cost estimate, Simple Problems - Estimation of production cost of simple components.

TOTAL : 45 PERIODS

TEXT BOOKS

1. I.L.O – Introduction to work study, 3rd ed. Universal Publishing Corporation, Bombay.
2. GUPTA AND PATEL, Work Study, Khanna Publishers.

REFERENCE BOOKS

1. Mundel, "Motion and Time Study", Prentice Hall of India, New Delhi, 1995.
2. Ralph M. Barnes, "Motion and Time Study", John Wiley and sons, 1990.
3. Niebel Benjamin. W., "Motion and Time Study", Richard D. Irwin Inc., 1982.
4. Dalela. S, "Work Study and Ergonomics", Standard Publishers Distributors, New Delhi, 1999.
5. Singh .C.K., "Mechanical Costing, Estimation and Project Planning", Standard Publishers Distributors, New Delhi, 1996.
6. G.B.S.Narangh, V.Kumar, " Production and Costing" Khanna Publishers, New Delhi, 1980.
7. Banga, Sharma, "Mechanical Estimating and Costing" Khanna Publishers, New Delhi, 1976.
8. Bridger, R.S., " Introduction to Ergonomics", McGraw Hill, 1995.

VII – SEMESTER

ELECTIVE – II

PME474A

DESIGN OF HEAT TRANSFER EQUIPMENTS

L T P C

3 0 0 3

UNIT - I

9

Thermal and hydraulic design – inner pipes – annulus, Hair pin heat exchangers – base inner tube – finned inner multitubes – parallel and series arrangements, pressure drop, constructional features.

Heat pipes – structures – applications – basic relations – performance characteristics – effects of working fluid and operating temperature, wick – selection of material – pore size.

UNIT - II

9

Basic components – shell – tube bundles – baffles – types and geometry. Design procedure – preliminary estimation of size, pressure drop and heat transfer calculations – shell and tube sides – Kenn method – Bell – Delaware method.

UNIT- III

9

Compact heat exchangers – types – constructional features, heat transfer and pressure drop calculation – finned plate and tube.

Gasketed – plate heat exchangers – constructional features – plate pack and frame – operational characteristics – flow arrangement, heat transfer and pressure drop calculation, performance analysis, comparison with other types of heat exchangers.

UNIT - IV

9

Shell and tube condensers – horizontal & vertical types – design and operational consideration, plate condensers, air cooled and direct contact types, condenser for refrigeration, evaporative condensers.

Evaporation for refrigeration & air conditioning – chillers, air coolers – thermal analysis – Shah Kandhkar and Ghngor and Wintertom correlations, standard types.

UNIT - V

9

Cooling towers – types – basic relation – heat balance and heat transfer – characteristics, effects of – packings – geometry, spray design, selection of – pumps, fans. Testing, maintenance, environmental effects, wind loads, typical installations.

TOTAL : 45 PERIODS

TEXTBOOK

- 1 ARTHUR P. FRAAS, Heat Exchanger Design, John Wiley & Sons, 1997.

REFERENCE BOOKS

- 1 SADIK KAKAC & HONGTAN LIN, Heat Exchangers, CRC Press, London, 1998.
- 2 KENN D, Process Heat transfer, Tata McGraw Hill, 1997.
- 3 WALKER, Industrial Heat Exchangers, McGraw Hill, 1980.
- 4 HOLGER MARTIN, Heat Exchangers, Hemisphere Publishing Corporation, London, 1982.

PME474B

CRYOGENIC ENGINEERING

L T P C

3 0 0 3

UNIT - I

9

INTRODUCTION - Cryogenic Engineering – properties of cryogenic fluids – oxygen, Nitrogen, Argon, Neon, Fluorine, Helium, Hydrogen. Properties of solids – mechanical, thermal and electrical – superconductivity.

UNIT - II

9

CRYOGENIC REFRIGERATION - Principle – Joule Thompson expansion, cascade processes, Ortho Para Hydrogen conversion, cold gas refrigerators, Linda Hampson cycles, Claude & Cascaded system, magnetic cooling, sterling cycle cryocoders.

UNIT - III

9

CRYOGENIC REQUIREMENTS - Cryogenic – heat exchangers, compressors, expanders, effect of various parameters in performance and system optimization. Insulation and storage equipment's for cryogenic fluids, industrial storage and transfer of cryogenic fluids.

UNIT – IV

9

GAS SEPARATION & PURIFICATION -Ideal gas, mixture characteristic – composite diagrams. Gas separation – principles of rectification, flash calculation, rectification column analysis – air separation, gas purification.

UNIT - V

9

CRYOGENIC INSTRUMENTATION - Properties and characteristic of instrumentation, strain, displacement, pressure, flow, liquid level, density and temperature measurements in cryogenic range.

TOTAL : 45 PERIODS

TEXT BOOKS

1. SCOTT, Cryogenic Engineering, Van Nostrand Co.. 1985

REFERENCES

1. RANDAL F. BARRON, Cryogenic Systems, McGrawHill, 1985.
2. FLYNN T.M. Cryogenic Engineering Maxwell Dekker, 1997.

PME474C

INTERNAL COMBUSTION ENGINES

L T P C

3 0 0 3

UNIT - I

9

Spark ignition engine – mixture requirements – feed back control carburetors – petrol injection systems – normal and abnormal combustion – factors affecting knock – shape of combustion chambers in SI engines.

UNIT - II

9

Normal and abnormal combustion in CI engines, direct and indirect ignition systems, combustion chambers – air movements in CI engines – fuel spray structure, spray generation and evaporation –turbo charging in IC engines.

UNIT - III

9

Alternate fuels – alcohol – hydrogen – natural gas – liquefied petroleum gas – suitability, engine modifications, merits and demerits as IC engine fuels.

UNIT - IV

9

Pollutants from IC engines – formation of NOX, CO and hydrocarbon, emission mechanism, particulate emission – method of controlling emissions – catalytic convectors and particulate traps – methods of measurements of emission and driving cycles.

UNIT - V

9

Stratified charge spark ignition engine – lean burn engines, dual fuel engine – multi point fuel injection gasoline engines – homogeneous charge compression ignition engines – plasma ignition, electric /hybrid vehicles.

TOTAL : 45 PERIODS

TEXT BOOKS

1. GANESAN V. Internal Combustion Engines, TMH, 2008, 3rd Edition.
2. GILL SMITH & ZURICH, Fundamentals of IC Engines.
3. MATHUR R.B AND SHARAM. R.B, Internal Combustion Engines, Dhanpat Rai & Sons, 1994.

REFERENCE BOOKS

1. DOMKUNDWAR V.M, Internal Combustion Engines, Dhanpat Rai & Sons, 1999
2. JOHN B. HEYWOOD, Internal Combustion Engine Fundamentals, McGraw Hill, 1988
3. P. L. Ballaney, Internal Combustion Engines, Khanna Publishers, 2006, 6th Edition

PME474D

PRODUCT DESIGN AND DEVELOPMENT

L T P C

3 0 0 3

OBJECTIVE:

- To Teach the students basic concepts of Product Design and Process Development.

Expose the students to the importance, various stages, concepts, management and prototyping of Product Design and Process Development.

UNIT I INTRODUCTION

9

Strategic importance of Product development - integration of customer, designer, material supplier and process planner, Competitor and customer - behavior analysis. Understanding customer-promoting customer understanding-involve customer in development and managing requirements - Organization process management and improvement.

UNIT II CONCEPT GENERATION, SELECTION AND TESTING

9

Plan and establish product specifications. Task - Structured approaches - clarification - search- externally and internally-Explore systematically - reflect on the solutions and processes - concept selection - methodology - benefits. Implications - Product change - variety - component standardization - product performance – manufacturability.

UNIT III PRODUCT ARCHITECTURE

9

Product development management - establishing the architecture - creation - clustering - geometric layout development - Fundamental and incidental interactions - related system level design issues - secondary systems -architecture of the chunks - creating detailed interface specifications-Portfolio Architecture.

UNIT IV INDUSTRIAL DESIGN

9

Integrate process design - Managing costs - Robust design - Integrating CAE, CAD, CAM tools – Simulating product performance and manufacturing processes

electronically - Need for industrial design-impact – design process - investigation of customer needs – conceptualization - refinement - management of the industrial design process.

UNIT V DESIGN FOR MANUFACTURING AND PRODUCT DEVELOPMENT 9

Definition - Estimation of Manufacturing cost-reducing the component costs and assembly costs – Minimize system complexity - Prototype basics - Principles of prototyping - Planning for prototypes - Economic Analysis.

TOTAL: 45 PERIODS

TEXT BOOK:

1. Ulrich K.T. and Eppinger S.D., “Product Design and Development” McGraw –Hill International Editions,1999.

REFERENCES:

- 1 Belz A., 36-Hour Course: “Product Development” McGraw-Hill, 2010.
- 2 Rosenthal S., “Effective Product Design and Development”, Business One Orwin, Homewood, 1992, ISBN 1-55623-603-4.
- 3 Pugh S., “Total Design – Integrated Methods for successful Product Engineering”, Addison Wesley Publishing, 1991, ISBN 0-202-41639-5.

PME474E

ROBOTIC TECHNOLOGY

L T P C

3 0 0 3

UNIT – I

9

INTRODUCTION - History of robotics – Configuration of manipulator – Arm and wrist - Work volume and spatial resolution – Linkage and joints of manipulators, drive systems, feedback devices, Concepts of degrees of freedom, types of end effectors – Basic sensors in robotics including machine vision

UNIT - II

9

COORDINATE FRAMES AND TRANSFORMATION - Coordinate frames – Description of objects in space – Various types of transformations of vectors – Basic transformation matrices – Forward and inverse kinematic equations – Danavit and Hartenberg representation – Inverse kinematic solution

UNIT - III

9

DIFFERENTIAL MOTION OF MANIPULATORS - Differential relationships, Jacobian of manipulator – Inverse Jacobian, Static analysis

UNIT- IV**9**

DYNAMIC FORCES AND TRAJECTORY PLANNING - Lagrangian mechanics, Dynamic equations for multi degree of freedom manipulators – Inverse dynamics – Joint space planning – Cartesian space planning – Linear feedback control, Decoupling control – Force control strategies

UNIT - V**9**

ROBOT PROGRAMMING AND APPLICATIONS - Methods of robots programming – lead and teach method - Explicit languages, task level languages – Introduction – Workcell design and control, Robot cycle time analysis Industrial Applications – machining – welding – assembly – material handling – loading and unloading – hostile and remote environments – Economics of robots.

TOTAL : 45 PERIODS**TEXTBOOKS**

1. MIKELL P. GROOVER, Industrial Robotics, MGH, 1996.
2. MOHSEN SHAHINPOOR, A Robot Engineering Text Book, Harper & Row,

REFERENCE BOOKS

1. JOHN J. CRAIG, Introduction to Robotics, Addison Wesley, ISE, 1999
2. ARTHUR CRICHLLOW, Introduction to Robotics, Macmillan, 1985.
3. YORAM KOREN, Robotics for Engineers, MGH, 1985.
4. FRANCIS N. NAGY, Engineering Foundation of Robotics, Addison Wesley,

PME474F**TRIBOLOGY****L T P C****3 0 0 3****UNIT - I****9**

DRY FRICTION - Dry friction – topography of surfaces – contact between surfaces – sliding friction – energy dissipation. Theory of molecular attraction – fretting corrosion and prevention – variables in dry friction – present concept of friction – boundary friction – oiliness – variables of boundary friction – friction characteristics of metals and non-metals– rolling friction – sources of measurement of friction.

UNIT - II**9**

Wear – types – mechanism – factors affecting wear. Adhesive wear – abrasive wear, fatigue wear – corrosive wear – brittle fracture wear. Delamination – wear measurement.

UNIT - III**9**

Fundamentals of viscosity and flow – Petroff's equation – friction torque – viscosity measurement – factors affecting viscosity. Principle of hydrostatic lubrication – hydrostatic step bearing – multi recess bearing – design problems – different types of compensation and their effect on bearing, parameters – hydrostatic lift, simple problems – hydrostatic journal bearing, simple problems – hydrostatic squeeze films.

UNIT - IV**9**

HYDRODYNAMIC LUBRICATION - Solution of Reynolds equation – application to tilting pad thrust bearing – design of hydrodynamic journal bearings – force feed of oil flow with various types of grooves – dynamic bearings and rotor systems – brief discussion, lubrication systems, bearing materials – gas bearings – brief discussion – elastohydrodynamic lubrication – brief discussion.

UNIT - V**9**

LUBRICANTS AND MAINTENANCE - Lubricants – types-solids ,and liquid-properties-additives-testing-reclamation of lubricants, surface treatment-phosphating of metal surface, Teflon coating. Predictive maintenance-signature analysis and condition monitoring-basic principles-instrumentation.

TOTAL : 45 PERIODS**TEXT BOOKS**

- 1 HUTCHINGS. M, Tribology, Friction and Wear of Engg. Materials, Edward Arnold, London, 1992.
- 2 MAJUMDAR, Introduction of Tribology of Bearings, A.H.Wheeler & Co., 1986.

REFERENCES

- 1 NCALC, NEWNCS, Tribology Handbook, Butterworths, 1975.
- 2 DUDLEY D.FULLER, Theory and Practice of Lubrication for Engineers, John Wiley & Sons, 1984.
- 3 CAMERON.A, Basic Lubrication Theory, Wiley Eastern Ltd., 1987.
- 4 BHARAT BHUSAN & B.K.GUPTA, Handbook of Tribology, McGraw Hill Inc., 1991.

(APPROVED HAND BOOK MAY BE USED IN THE EXAMINATION)

OBJECTIVES:

- To understand material removal by using various forms of energy and machining new materials and complex parts with high accuracy by using non-traditional machining.

UNIT I INTRODUCTION 7

Need of Non-Traditional Machining Processes – Classification Based on Energy, Mechanism, source of energy, transfer media and process - Process selection- Based on Physical Parameters, shapes to be machined, process capability and economics – Overview of all processes.

UNIT II MECHANICAL PROCESS 10

Ultrasonic Machining: Principle- Transducer types – Concentrators - Abrasive Slurry - Process Parameters – Tool Feed Mechanism – Advantages and Limitations – Applications. Abrasive Jet Machining: Process- Principle – Process Variables – Material Removal Rate - Advantages and Limitations – Applications. Water Jet Machining: Principle – Process Variables - Advantages and Limitations – Practical Applications – Abrasive water jet machining process.

UNIT III ELECTRICAL DISCHARGE MACHINING 10

Electrical Discharge Machining: Mechanism of metal removal – Dielectric Fluid – Flushing methods - Electrode Materials - Spark Erosion Generators – Electrode Feed System – Material Removal Rate – Process Parameters – Tool Electrode Design – Tool wear Characteristics of Spark Eroded Surfaces- Advantages and Limitations – Practical Applications. Electrical Discharge Wire Cut and Grinding: Principle – Wire Feed System - Advantages and Limitations –Practical Applications

UNIT IV CHEMICAL AND ELECTRO CHEMICAL MACHINING 10

Chemical Machining: fundamentals, Principle –classification and selection of Etchant - chemical milling, Engraving, Blanking - Advantages and limitations – Applications. Electro Chemical Machining: Electro-chemistry of the process-Electrolytes - Electrolyte and their Properties – Material Removal Rate – Tool Material – Tool Feed System – Design For Electrolyte Flow – Process Variables - Advantages and Limitations – Applications - Electro Chemical Grinding: Honing, cutting off, Deburring and turning.

UNIT V HIGH ENERGY MACHINING PROCESS 8

Electron Beam Machining: Principle –Generation and control of electron beam- Advantages and Limitations – Applications. Laser Beam Machining: Principle –Solid and Gas Laser Application – Thermal Features of LBM - Advantages and

Limitations – Applications. Ion Beam Machining: Equipment – process characteristics - Advantages and Limitations – Applications. Plasma Arc Machining: Principle –Gas mixture– Types of Torches – Process Parameters - Advantages and Limitations – Applications. Ion Beam Machining – Principle – MRR – advantages, limitation, applications.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. P.C Pandey And H.S. Shan, “Modern Machining Process”, Tata Mc Graw – Hill Publishing Company Limited, New Delhi, 2007
2. V.K. Jain, “ Advanced Machining Process”, Allied Publishers Pvt Limited 2007

REFERENCES:

1. Amithaba Bhattacharyya , “New Technology”, The Institution Of Engineers , (India) “Production Technology”, HMT Bangalore, Tata Mc Graw–Hill Publishing Company Limited, New Delhi, 2006.
2. Hassan El – Hofy “Advanced machining Processes” MC Graw-Hill, 2005.

PME474H

THEORY OF METAL FORMING

**L T P C
3 0 0 3**

OBJECTIVES:

- This course aims to impart the knowledge about various metal forming processes. It deals with metal forming concepts like theory of plasticity and special metal forming techniques. After this course a student will have a good exposure about this subject. This also gives the recent trends in the metal forming processes.

UNIT- I THEORY OF PLASTICITY

9

Theory of plastic deformation – Engineering stress and strain relationship – Strain rate – Stress tensor – Strain tensor – Yield criteria – Plastic stress strain relationship – Plastic work
– Plastic anisotropy.

UNIT - II CONSTITUTIVE RELATIONSHIPS AND INSTABILITY

7

Uniaxial tension test – Mechanical properties – Work hardening, Compression test, bulge test, plane strain compression, plastic instability in uniaxial tension stress, plastic instability in biaxial tension stress – Material models – Elasto plasticity, Rigid plasticity, visco plasticity.

UNIT - III ANALYSIS OF METAL FORMING

12

Slab analysis – Slip line method, upper bound solutions, numerical methods, contact

problems, effect of friction, thermo elastic- analysis of forging, rolling, extrusion and wire drawing processes – forming load – Net and Near net shape forming – Cold and Hot Forging.

UNIT- IV SHEET METAL FORMING

8

Sheet Metal Forming methods – Bending – Drawing – Deep Drawing – Stretch Forming – Formability and workability – Forming limit diagram – Analysis of Sheet Metal Forming – HERF Techniques – Principles and Process Parameters – Superplastic Forming.

UNIT - V SPECIAL METAL FORMING PROCESSES

9

Orbital forging, Isothermal forging, Warm forging, Hot and Cold isotrophical pressing, high speed extrusion, rubber pad forming, micro blanking – Overview of Powder Metal Techniques
– Powder rolling.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Dieter G.E, “Mechanical Metallurgy” Mc Graw – Hill Co. S1. Edition 1995
2. Surender Kumar, “Technology of Metal Forming Processes”, PHI, New Delhi, 2008.

REFERENCES:

- 1 Nagpal G.R “Metal Forming Process”, Kanna Pub, New Delhi – 2000.
- 2 Wagoner, R.H and Chenot, JJ Metal Forming Analysis, Cambridge University Press,2002.
- 3 Slater, R.A.C., Engineering Plasticity – Theory and Applications to Metal Forming, John Wiley and Sons, 1987.
- 4 Shiro Kobayshi, Altan. T, Metal Forming and Finite Element Method, Oxford University Press, 1989.
- 5 Hosford, W.F and Caddell, R.M., Metal Forming Mechanics and Metallurgy, Prentice Hall Eaglewood Cliffs, 1993.6 Narayanaswamy. R, Theory of Metal Forming and Plasticity Narosa Publishers, 1999.
- 7 Kurt Lange, “Handbook of Metal Forming”, Society of Manufacturing Engineers, Michigan, USA, 1988.
- 8 Avitzur, “Metal Forming – Process and Analysis”, Tata McGraw-Hill Co., New Delhi,

OBJECTIVE:

- To study the manufacturing methods of automotive components and its developments

UNIT I INTRODUCTION TO AUTOMOTIVE COMPONENTS 9

Elements of automotive components manufacturing- Cylinder blocks, materials and production-Liners, Cylinders heads, materials and Production methods-Production of oil pan- Engine Mountings.

UNIT II ENGINE PARTS 9

Piston-types- materials-manufacturing methods-Piston rings-production-testing methods

-Piston pin-types-materials-manufacturing methods-Production of connecting rod and crankshaft.

UNIT III VALVES TRAIN AND FUEL SYSTEM 9

Valves-Materials-Production methods, Production valve train assembly- Cam shafts-manufacturing methods. Fuel system for petrol and diesel engines-principles of carburetors- fuel pumps-fuel injection pumps.

UNIT IV TRANSMISSION SYSTEM AND OTHER ACCESSORIES 9

Transmission system-gear box-types-clutch system, Brakes ,suspension- - cooling and lubrication system, ignition system -turbochargers, superchargers.

UNIT V MODERN MANUFACTURING METHODS 9

Need of modern trend – Application of CAD, CAM, and Robotics- Latest technology and innovation- Electric , hybrid, fuel cell powered vehicle.

TOTAL: 45 PERIODS

TEXT BOOK:

- 1 Yamagata H., “The science and technology of materials in automotive engines”, Wood Head publishing Limited, 2005

REFERENCE BOOKS:

- 1 Nunney M.J., “Light and Heavy Vehicle Technology”, Elsevier Ltd.,2007,Fourth Edition.
- 2 Garrett T.K., Newton K. and Steeds W., “The Motor Vehicle” , Butterworth-Heinemann”,2001,Thirteenth Edition.

OBJECTIVE:

- Study of this subject provides an understanding of the scope of an entrepreneur, key areas of development, financial assistance by the institutions, methods of taxation and tax benefits, etc.

UNIT I ENTREPRENEURSHIP**9**

Entrepreneur – Types of Entrepreneurs – Difference between Entrepreneur and Intrapreneur

– Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurial Growth.

UNIT II MOTIVATION**9**

Major Motives Influencing an Entrepreneur – Achievement Motivation Training, self Rating, Business Game, Thematic Apperception Test – Stress management, Entrepreneurship Development Programs – Need, Objectives.

UNIT III BUSINESS**9**

Small Enterprises – Definition, Classification – Characteristics, Ownership Structures – Project Formulation – Steps involved in setting up a Business – identifying, selecting a Good Business opportunity, Market Survey and Research, Techno Economic Feasibility Assessment

– Preparation of Preliminary Project Reports – Project Appraisal – Sources of Information – Classification of Needs and Agencies.

UNIT IV FINANCING AND ACCOUNTING**9**

Need – Sources of Finance, Term Loans, Capital Structure, Financial Institution, management of working Capital, Costing, Break Even Analysis, Network Analysis Techniques of PERT/ CPM – Taxation – Income Tax, Excise Duty – Sales Tax.

UNIT V SUPPORT TO ENTREPRENEURS**9**

Sickness in small Business – Concept, Magnitude, causes and consequences, Corrective Measures – Government Policy for Small Scale Enterprises – Growth Strategies in small industry – Expansion, Diversification, Joint Venture, Merger and Sub Contracting.

TOTAL: 45 PERIODS**TEXT BOOKS:**

1. S.S.Khanka “Entrepreneurial Development” S.Chand & Co. Ltd. Ram Nagar New Delhi, 1999.
2. Kuratko & Hodgetts, “Enterprenuership – Theory, process and practices”,

OBJECTIVE:

- To make students to understand various Non Destructive testing methods including advanced techniques, with emphasis on basic principles, limitations and application areas.

UNIT I INTRODUCTION 9

Visual methods: Optical aids, In-situ metallography, Optical holographic methods, Dynamic inspection.

UNIT II LIQUID PENETRANT & MAGNETIC INSPECTION 9

Penetrant systems: Principles-Process- Liquid penetrant materials-Emulsifiers-cleaners developers-sensitivity-Advantages, Limitations and Applications .Magnetic methods: Advantages, Limitations-Methods of generating fields: magnetic particles and suspending liquids Magnetography-field sensitive probes: applications. Measurement of metal properties.

UNIT III RADIOGRAPHIC METHODS 9

Principles of radiography- sources of radiation- Ionising radiation -sources-X-rays, gama rays- Recording of radiation-Radiographic sensitivity-Fluoroscopic methods-special techniques- Radiation safety. Advantages ,Limitations and applications.

UNIT IV ULTRASONIC TESTING OF MATERIALS 9

Advantages, disadvantages, Applications, Generation of. Ultrasonic waves, general characteristics of ultrasonic waves: methods and instruments for ultrasonic materials testing: special techniques.

UNIT V ELECTRICAL AND OTHER METHODS 9

Electrical methods:Eddy current methods: potential-drop methods, applications- Other methods: Acoustic Emission methods, Acoustic methods: Leak detection: Thermal inspection.

TOTAL: 45 PERIODS

TEXT BOOKS:

- 1 Halmshaw R., "Non Destructive Testing", Edward Arnold Publication, London, 1987.
- 2 Hull B. and John V., "Non-destructive testing", English Language Book Soc., 1989.

- 3 Ravi Prakash, "Non destructive Testing Techniques", New Age Science, 2009.

REFERENCES:

- 1 Metals Handbook, "Nondestructive Inspection and Quality Control", Vol. 17, 9th Edition, ASM International
- 2 Hellier C., "Handbook of Non destructive Evaluation", McGraw-Hill Professional, 1 edition, 2001.
- 3 "Non destructive Testing Handbook", Vol. 1-10, 3rd Edition, American Society for Non Destructive Testing, 2010.

PME474L

ADDITIVE MANUFACTURING TECHNOLOGY

L T P C

3 0 0 3

OBJECTIVES:

- To know the principle methods, areas of usage, possibilities and limitations as well as environmental effects of the Additive Manufacturing technologies
- To be familiar with the characteristics of the different materials those are used in Additive Manufacturing.

UNIT I INTRODUCTION

10

Overview – History - Need-Classification -Additive Manufacturing Technology in product development-Materials for Additive Manufacturing Technology – Tooling - Applications.

UNIT II CAD & REVERSE ENGINEERING

10

Basic Concept – Digitization techniques – Model Reconstruction – Data Processing for Additive Manufacturing Technology: CAD model preparation – Part Orientation and support generation – Model Slicing –Tool path Generation – Softwares for Additive Manufacturing Technology: MIMICS, MAGICS.

UNIT III LIQUID BASED AND SOLID BASED SYSTEMS

10

Classification – Liquid based system – Stereolithography Apparatus (SLA)- Principle, process, advantages and applications - Solid based system –Fused Deposition Modeling - Principle, process, advantages and applications, Laminated Object Manufacturing.

UNIT IV POWDER BASED SYSTEMS

10

Selective Laser Sintering – Principles of SLS process - Process, advantages and applications, Three Dimensional Printing - Principle, process, advantages and applications- Laser Engineered Net Shaping (LENS), Electron Beam Melting.

UNIT V MEDICAL AND BIO-ADDITIVE MANUFACTURING 5

Customized implants and prosthesis: Design and production. Bio-Additive Manufacturing- Computer Aided Tissue Engineering (CATE) – Case studies

TOTAL : 45 PERIODS

TEXT BOOKS:

- 1 Chua C.K., Leong K.F., and Lim C.S., “Rapid prototyping: Principles and applications”, Third edition, World Scientific Publishers, 2010.
- 2 Gebhardt A., “Rapid prototyping”, Hanser Gardener Publications, 2003.

REFERENCES:

- 1 Liou L.W. and Liou F.W., “Rapid Prototyping and Engineering applications : A tool box for prototype development”, CRC Press, 2007.
- 2 Kamrani A.K. and Nasr E.A., “Rapid Prototyping: Theory and practice”, Springer, 2006.
- 3 Hilton P.D. and Jacobs P.F., “Rapid Tooling: Technologies and Industrial Applications”, CRC press, 2000.