

B.TECH. MECHANICAL ENGINEERING

(3 ½ Years Part time Programme)

CURRICULUM AND SYLLABUS

(Regulation 2017)

The total credits required for completing the
B.Tech. Programme in Mechanical Engineering is 116.



**PERIYAR
MANIAMMAI
UNIVERSITY**

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DEPARTMENT OF MECHANICAL ENGINEERING

Periyar Maniammai University

Vallam, Thanjavur - 613 403

MAY 2017

SEMESTER I

Code No	Course Title	L	T	P	C
Theory					
PME101	Mathematics - I	3	1	0	4
PME102	Strength of Materials	3	1	0	4
PME103	Fluid Mechanics and Machinery	3	0	0	3
PME104	Engineering Materials and Metallurgy	3	0	0	3
Practical					
PME105	Strength of Materials and Fluid machinery Lab	0	0	3	2

Total Hours: 17

Total Credits: 16

SEMESTER II

Code No	Course Title	L	T	P	C
Theory					
PME201	Probability and Statistics	3	1	0	4
PME202	Mechanics of Machines - I	3	1	0	4
PME203	Thermal Engineering	3	0	0	3
PME204	Metrology and Measurements	3	0	0	3
Practical					
PME205	Thermal Engineering Lab - I	0	0	3	2

Total Hours: 17

Total Credits: 16

SEMESTER - III

Code No	Course Title	L	T	P	C
Theory					
PME301	Numerical Methods	3	1	0	4
PME302	Gas Dynamics and Shock Waves	3	1	0	4
PME303	Machine Element Design	3	1	0	4
PME304	CAD/CAM	3	0	0	3
Practical					
PME305	CAD/ CAM Lab	0	0	3	2

Total Hours: 18

Total Credits: 17

SEMESTER IV

Code No	Course Title	L	T	P	C
Theory					
PME401	Design of Transmission Systems	3	1	0	4
PME402	Manufacturing Technology	3	0	0	3
PME403	Heat and Mass Transfer	3	1	0	4
PME404	Mechanics of Machines - II	3	1	0	4
Practical					
PME405	Heat and Mass Transfer lab	0	0	3	2

Total Hours: 18

Total Credits: 17

SEMESTER V

Code No	Course Title	L	T	P	C
Theory					
PME501	Operations Research	3	1	0	4
PME502	Engineering Economics & Cost analysis	3	0	0	3
PME503	Power Plant Engineering	3	0	0	3
PME504	Mechatronics	3	0	0	3
Practical					
PME505	Special Machines Lab	0	0	3	2

Total Hours: 16**Total Credits: 15****SEMESTER VI**

Code No	Course Title	L	T	P	C
PME601	Materials Management & Industrial Engineering	3	0	0	3
PME602	Automobile Engineering	3	0	0	3
PME603*	Elective-I	3	0	0	3
PME604*	Elective-II	3	0	0	3
Practical					
PME605	Automobile Engineering Lab	0	0	3	2

Total Hours: 15**Total Credits: 14****SEMESTER VII**

Code No	Course Title	L	T	P	C
PME701	Social Engineering	3	0	0	3
PME702*	Elective - III	3	0	0	4
PME703*	Elective - IV	3	0	0	3
Practical					
PME704	Project Work	0	0	20	12

Total Hours: 29**Total Credits: 22****Total Credits: 116**

LIST OF ELECTIVES

ELECTIVE I

* Elective Code	Course Title	L	T	P	C
PME 603A	Refrigeration& Air conditioning	3	0	0	3
PME 603B	Fluid Power Engineering	3	0	0	3
PME 603C	Energy Conversion Systems	3	0	0	3

ELECTIVE II

* Elective Code	Course Title	L	T	P	C
PME 604A	Nano Technology	3	0	0	3
PME 604B	Optimum Utilization of Heat and Power	3	0	0	3
PME 604C	Advanced I.C Engines	3	0	0	3

ELECTIVE III

* Elective Code	Course Title	L	T	P	C
PME 702A	Mathematical Modeling and simulation- MATLAB	3	0	0	4
PME 702B	Computational Fluid Dynamics	3	0	0	4
PME 702C	Finite Element Methods	3	0	0	4

ELECTIVE IV

* Elective Code	Course Title	L	T	P	C
PME 703A	Automation and Control Engineering	3	0	0	3
PME 703B	Modern Manufacturing Technology- JIT, AMT	3	0	0	3
PME 703C	Reliability Engineering	3	0	0	3
PME 703D	Tribology	3	0	0	3

PME 101 - Mathematics - I (Matrices, Differential Calculus, Ordinary Differential Equations)

(Common to All B.Tech programme)

(Applicable Codes: XAE102 / XBT102 / XCE102 / XCH102 / XCS102/ XEC102 / XEE102/ XIT102 / XME101)

L	T	P	C
3	1	0	4
			9

UNIT I MATRICES

Eigen values and Eigenvectors of a real matrix – Properties of Eigen values and Eigen vectors - Cayley - Hamilton theorem (excluding proof) - Similarity transformation (Concept only) – Orthogonal matrix - Orthogonal transformation of a symmetric matrix to diagonal form – Reduction of quadratic form to Canonical form by Orthogonal transformation.

UNIT II GEOMETRICAL APPLICATIONS OF DIFFERENTIAL CALCULUS 9

Curvature – Cartesian and polar co – ordinates – Centre and radius of curvature – Circle of curvature – Involutives and evolutes – Envelopes – Properties of envelopes and evolutes.

UNIT III FUNCTIONS OF SEVERAL VARIABLES 9

Functions of two variables – Partial derivatives – Total differentiation – Taylor’s expansion – Maxima and Minima – Constrained maxima and minima – Lagrange’s Multiplier method – Jacobian Determinants.

UNIT IV FIRST ORDER DIFFERENTIAL EQUATIONS 9

Exact differential equations - Solution to exact differential equations – Solution to non exact differential equations with integrating factor – Clairaut’s form - Equations reducible to Clairaut’s form – Application (Growth and decay problems – Newton’s law of cooling).

UNIT V ORDINARY DIFFERENTIAL EQUATIONS AND APPLICATIONS 9

Linear equations of second and higher order with constant and variable coefficients (Euler’s and Legendre’s equations) – Simultaneous first order linear equations with constant coefficients – Method of variation of parameters - Applications to electrical circuit problems.

L: 45

T: 15

Total : 60

TEXT BOOK :

1. Grewal B.S, Higher Engineering Mathematics, 40th Edition- Khanna Publications – New Delhi, 2004.
2. Kreyszig E, “Advanced Engineering Mathematics”, 8th Edition-John Wiley & Son (Asia) Ltd, Singapore, 2001.

REFERENCES:

1. Bali N.P, Narayana Iyengar, Engineering Mathematics, Laxmi Publications (P). Ltd - New Delhi, 2003.
2. Veerarajan T, Engineering Mathematics (For First Year), 4th Edition, Tata - McGraw Hill Publishing Company Ltd, New Delhi, 2005.
3. Kandasamy P, Thilagavathy K, and Gunavathy K, Engineering Mathematics- Volume I & II, S. Chand & Co, New Delhi, 2005.
4. Venkataraman M. K, Engineering Mathematics - Volume I & II, Revised enlarged 4th Edition, The National Publishing Company, Chennai, 2004.
5. Nptel – audio – visual Website: 1. www. NPTEL.com 2. www.NMEICT.com

Unit I STRESS, STRAIN AND DEFORMATION OF SOLIDS 9

Rigid and Deformable bodies – Strength, Stiffness and Stability – Stresses; Tensile, Compressive and Shear – Deformation of simple and compound bars under axial load – Thermal stress – Elastic constants – Strain energy and unit strain energy – Strain energy in uniaxial loads.

Unit II BEAMS - LOADS AND STRESSES 9

Types of beams: Supports and Loads – Shear force and Bending Moment in beams – Cantilever, Simply supported and Overhanging beams – Stresses in beams – Theory of simple bending – Stress variation along the length and in the beam section – Effect of shape of beam section on stress induced – Shear stresses in beams – Shear flow.

Unit III TORSION 9

Analysis of torsion of circular bars – Shear stress distribution – Bars of Solid and hollow circular section – Stepped shaft – Twist and torsion stiffness – Compound shafts – Fixed and simply supported shafts – Application to close-coiled helical springs – Maximum shear stress in spring section including Wahl Factor – Deflection of helical coil springs under axial loads – Design of helical coil springs – stresses in helical coil springs under torsion loads

Unit IV BEAM DEFLECTION 9

Elastic curve of Neutral axis of the beam under normal loads – Evaluation of beam deflection and slope: Double integration method, Macaulay Method, and Moment-area Method – Columns – End conditions – Equivalent length of a column – Euler equation – Slenderness ratio – Rankine formula for columns

Unit V ANALYSIS OF STRESSES IN TWO DIMENSIONS 9

Biaxial state of stresses – Thin cylindrical and spherical shells – Deformation in thin cylindrical and spherical shells – Biaxial stresses at a point – Stresses on inclined plane – Principal planes and stresses – Mohr's circle for biaxial stresses – Maximum shear stress - Strain energy in bending and torsion.

L:45; T:15;T : 60

TEXT BOOK

1. Popov E.P, "Engineering Mechanics of Solids", Prentice-Hall of India, New Delhi, 1997.
2. Beer F. P. and Johnston R, "Mechanics of Materials", McGraw-Hill Book Co, Third Edition, 2002.

REFERENCES

1. Nash W.A, "Theory and problems in Strength of Materials", Schaum Outline Series, McGraw-Hill Book Co, New York, 1995
2. Kazimi S.M.A, "Solid Mechanics", Tata McGraw-Hill Publishing Co, New Delhi, 1981
3. Ryder G.H, "Strength of Materials", Macmillan India Ltd., Third Edition, 2002
4. Ray Hulse, Keith Sherwin & Jack Cain, "Solid Mechanics", Palgrave ANE Books, 2004.
5. Singh D.K "Mechanics of Solids" Pearson Education 2002.
6. Timoshenko S.P, "Elements of Strength of Materials", Tata McGraw-Hill, New Delhi 1997.

Fluid – definition, distinction between solid and fluid - Units and dimensions - Properties of fluids - density, specific weight, specific volume, specific gravity, temperature, viscosity, compressibility, vapour pressure, capillary and surface tension - Fluid statics: concept of fluid static pressure, absolute and gauge pressures - pressure measurements by manometers and pressure gauges.

Unit II**FLUID KINEMATICS AND FLUID DYNAMICS****12**

Fluid Kinematics - Flow visualization - lines of flow - types of flow - velocity field and acceleration - continuity equation (one and three dimensional differential forms)- Equation of streamline - stream function - velocity potential function - circulation - flow net – fluid dynamics - equations of motion - Euler's equation along a streamline - Bernoulli's equation – applications - Venturi meter, Orifice meter, Pitot tube - dimensional analysis - Buckingham's π theorem-applications - similarity laws and models.

Unit III INCOMPRESSIBLE FLUID FLOW**12**

Viscous flow – Navier - Stoke's equation (Statement only) - Shear stress, pressure gradient relationship - laminar flow between parallel plates - Laminar flow through circular tubes (Hagen poiseuille's) - Hydraulic and energy gradient - flow through pipes - Darcy - weisback's equation - pipe roughness -friction factor- Moody's diagram-minor losses - flow through pipes in series and in parallel - power transmission - Boundary layer flows, boundary layer thickness, boundary layer separation - drag and lift coefficients.

Unit IV HYDRAULIC TURBINES**8**

Fluid machines: definition and classification - exchange of energy - Euler's equation for turbo machines - Construction of velocity vector diagrams - head and specific work - components of energy transfer - degree of reaction.

Hydro turbines: definition and classifications - Pelton turbine - Francis turbine - propeller turbine - Kaplan turbine - working principles - velocity triangles - work done - specific speed - efficiencies -performance curve for turbines.

Unit V**HYDRAULIC PUMPS****7**

Pumps: definition and classifications - Centrifugal pump: classifications, working principle, velocity triangles, specific speed, efficiency and performance curves - Reciprocating pump: classification, working principle, indicator diagram, work saved by air vessels and performance curves - cavitations in pumps - rotary pumps: working principles of gear and vane pumps

L:45; T:0; Total Hours: 45**TEXT BOOKS**

1. Streeter, V.L., and Wylie, E.B., "Fluid Mechanics", McGraw-Hill, 1983.
2. Kumar, K.L., "Engineering Fluid Mechanics", Eurasia Publishing House (P) Ltd, New Delhi (7th edition), 1995.
3. Vasandani, V.P., "Hydraulic Machines - Theory and Design", Khanna Publishers.1992

REFERENCES

1. Bansal, R.K., "Fluid Mechanics and Hydraulics Machines", (5th edition), Laxmi publications (P) Ltd, New Delhi, 1995
2. White, F.M., "Fluid Mechanics", Tata McGraw-Hill, 5th Edition, New Delhi, 2003.
3. Ramamirtham, S., "Fluid Mechanics and Hydraulics and Fluid Machines", Dhanpat Rai and Sons, Delhi, 1998.
4. Som, S.K., and Biswas, G., "Introduction to Fluid Mechanics and Fluid Machines", Tata McGraw-Hill, 2nd Edition, 2004.

LIST OF EXPERIMENTS

1. Hardness test on metals - Brinnell and Rockwell Hardness Number
2. Deflection test on beams
3. Compression test on helical springs
4. Determination of the Coefficient of discharge of given Orifice meter and venturi meter.
5. Determination of friction factor and losses for a given set of pipes.
6. Conducting experiments and drawing the characteristic curves of centrifugal pump / submersible pump
7. Conducting experiments and drawing the characteristic curves of reciprocating pump.
8. Conducting experiments and drawing the characteristic curves of Gear pump.
9. Conducting experiments and drawing the characteristic curves of Pelton wheel.
10. Conducting experiments and drawing the characteristics curves of Francis turbine.
11. Conducting experiments and drawing the characteristic curves of Kaplan turbine.
12. Determination of static and Dynamic pressure on pitot tube

Total Hours: 45

LIST OF EXPERIMENTS

1. Valve Timing Diagram for single cylinder four stroke Diesel engine
2. Port Timing Diagram for single cylinder two stroke Petrol engine .
3. Performance Test on 4-stroke Single Cylinder water-cooled Diesel Engine.
4. Heat Balance Test on 4-stroke Twin cylinder water-cooled Diesel Engine.
5. Morse Test on four Stroke Multi cylinder Petrol Engine.
6. Retardation Test to find Frictional Power of a single cylinder Diesel Engine.
7. Determination of Viscosity – Red Wood Viscometer.
8. Determination of Flash Point and Fire Point(open Cup).
9. Determination of Flash Point (Closed Cup).

Total Hours : 45

PME301 Numerical Methods
(Common to All B.E/B.Tech Programmes)

(Applicable Codes: XCE301/XCS501/XEC502/XEE401/XME501/XAE401/XCH401/XBT401/XIT502)

L T P C
3 1 0 4

UNIT – I Unit – I Solution of equations and eigen value problems

Solution of algebraic and transcendental equations - method of false position – Newton’s method – Fixed point iteration method $x=g(x)$ method- Solution of linear system of equations - Gauss elimination and Gauss – Jordan methods – Iterative methods - Gauss Jacobi and Gauss – Seidel methods – Inverse of a matrix by Gauss – Jordan method – Eigen value of a matrix by power method.

Unit – II Interpolation and Approximation

9

Interpolation with unequal intervals - Lagrangian Polynomials – Divided difference – Newton’s divided difference interpolation - Interpolation with equal intervals - Newton’s forward and backward difference formulae.

Unit – III Numerical Differentiation and Integration

9

Approximation of derivatives using interpolation polynomials – Numerical integration using Trapezoidal, Simpson’s 1/3 and 3/8 rules – Romberg’s method – Two and three point Gaussian quadrature formulae – Double integrals using Trapezoidal and Simpson’s rules.

Unit – IV Initial Value Problems for Ordinary Differential Equations

9

Single step Methods : Taylor Series method – Euler and Modified Euler method – Fourth order Runge – Kutta method for solving first and second order equations – Multi-step methods: Milne’s and Adam’s Bashforth predictor and corrector methods.

Unit – V Boundary Value Problems in ordinary and partial differential equations

9

Finite difference solution for the second order ordinary differential equations – Finite difference techniques for the solution of two dimensional Laplace and Poisson equations - one dimensional heat flow equation by explicit and implicit methods – One dimensional wave equation by explicit method

L:45; T:15;Total: 60

Text Book

1. Grewal, B.S. and Grewal, J.S., “Numerical Methods in Engineering and Science”, y Sixth Edition Khanna Publishers, Delhi, 2004.
2. Sankara Rao K, “Numerical Methods for Scientists and Engineers”, 3rd edition, Prentice Hall of India Private Ltd., New Delhi 2007

References

1. Jain M.K., Iyengar S.R.K. and Jain R.K., “Numerical Methods for Scientific and Engineering Computation” Fourth Edition, New Age International Publisher, 2003.
2. Gerald C.F. and Wheatley P.O., “ Applied Numerical Analysis”, Sixth Edition, Pearson Education, 2005.
3. Kandasamy P., Thilakavathy K. and Gunavathy K., “Numerical Methods”, Second Edition S.Chand & Co., 2003.
4. Venkatraman M.K., “Numerical Methods”, National Publication Company, 1991.

COMPRESSIBLE FLOW – FUNDAMENTALS**7**

Energy and momentum equations for compressible fluid flows, various regions of flows, reference velocities, stagnation state, velocity of sound, critical states, Mach number, critical Mach number, types of waves, Mach cone, Mach angle, effect of Mach number on compressibility

FLOW THROUGH VARIABLE AREA DUCTS**8**

Isentropic flow through variable area ducts, T-s and h-s diagrams for nozzle and diffuser flows, area ratio as a function of Mach number, mass flow rate through nozzles and diffusers, effect of friction in flow through nozzles.

FLOW THROUGH CONSTANT AREA DUCTS**9**

Flow in constant area ducts with friction (Fanno flow) – Fanno curves and Fanno flow equation, variation of flow properties, variation of Mach number with duct length. Isothermal flow with friction in constant area ducts Flow in constant area ducts with heat transfer (Rayleigh flow), Rayleigh line and Rayleigh flow equation, variation of flow properties, maximum heat transfer.

NORMAL SHOCK**12**

Shock waves overview, Hypersonic, shock waves in chemistry, shock waves and materials, shock waves and biology, Industrial applications of shock wave. Governing equations, variation of flow parameters like static pressure, static temperature, density, stagnation pressure and entropy across the normal shock, Prandtl - Meyer equation, impossibility of shock in subsonic flows, flow in convergent and divergent nozzle with shock, normal shock in Fanno and Rayleigh flows, flow with oblique shock (elementary treatment only).

PROPULSION**9**

Aircraft propulsion – types of jet engines – energy flow through jet engines, study of turbojet engine components – diffuser, compressor, combustion chamber, turbine and exhaust systems, performance of turbo jet engines – thrust, thrust power, propulsive and overall efficiencies, thrust augmentation in turbo jet engine, ram jet and pulse jet engines

Rocket propulsion – rocket engines thrust equation – effective jet velocity specific impulse – rocket engine performance, solid and liquid propellants, comparison of different propulsion systems.

TUTORIAL:15**TOTAL : 60**

Note: (Use of approved gas tables is permitted in the University examination)

TEXT BOOKS

- 1.Yahya. S.M., “Fundamental of compressible flow”, New Age International (p) Ltd., New Delhi, 1996.
2. Patrich.H. Oosthvizen, William E.Carscallen, “Compressible fluid flow”, McGraw-Hill, 1997

REFERENCES

- 1.Cohen. H., Rogers R.E.C and Sravanamutoo, “Gas turbine theory”, Addison Wesley Ltd., 1987.
- 2.Ganesan. V., “Gas Turbines”, Tata McGraw-Hill, New Delhi, 1999.
- 3.Rathakrishnan.E, “Gas Dynamics”, Prentice Hall of India, New Delhi, 2001.
4. Shock Wave Society, IISc. CD Material Released on NSSW2,27 & 28 Feb,2012

Unit I CAD/CAM INTERFACE**9**

Design process- Morphology of design - Product cycle - Sequential and concurrent engineering - Role of computers - Computer Aided Engineering - Computer Aided Design - Design for Manufacturability – Computer Aided Manufacturing - Benefits of CAD. Current trends in Manufacturing Engineering - Group Technology. CAPP.

Unit II INTERACTIVE COMPUTER GRAPHICS**10**

Creation of Graphic Primitives - Graphical input techniques - Display transformation in 2-D and 3-D – Viewing transformation - Clipping - hidden line elimination - Mathematical formulation for graphics - Curve generation techniques - Engineering Data Management System. Hierarchical data structure. Network data structure - Relational data structure.

Unit III SOLID MODELING**7**

Geometric Modeling - Wireframe, Surface and Solid models - CSG and B-REP Techniques - Features of Solid Modeling Packages - Parametric and features - Interfaces to drafting, Design Analysis.

Unit IV CNC SYSTEM**9**

CNC Technology - Functions of CNC Control in Machine Tools - Classification of CNC systems – Contouring System - Interpolators, open loop and closed loop CNC systems - CNC Controllers, Hardware features – Direct Numerical Control (DNC Systems).

Unit V PART PROGRAMMING FOR CNC MACHINES**10**

Numerical control codes - Standards - Manual Programming - Canned cycles and subroutines - Computer Assisted Programming, CAD / CAM approach to NC part programming - APT language, machining from 3D models.

TOTAL 45**Text Book:**

1. Sadhu Singh, " Computer Aided Design and Manufacturing ", Khanna Publishers, NewDelhi,
2. Groover and Zimmers, " CAD / CAM : Computer Aided Design and Manufacturing ",Prentice Hall of India, New Delhi

References:

1. Ibrahim Zeid, " CAD - CAM Theory and Practice ", Tata McGraw Hill Publishing Co. Ltd.,
2. P.Radhakrishnan and S.Subramanyan, " CAD / CAM / CIM ", Wiley Eastern Ltd., New Age International Ltd.,

List of Exercises using AutoCAD software capable of Drafting and Modeling

Study of capabilities of software for Drafting and Modeling – Coordinate systems (absolute, relative, polar, etc.) – Creation of simple figures like polygon and general multi-line figures.

Drawing front view, top view and side view of the following Mechanical Parts in 2D

- Flange coupling Protected Type
- Gib and Cotter Joint
- Universal Coupling
- Screw Jack etc.

Assembling the following Mechanical Parts in 3D

- Flange coupling Protected Type
- Gib and Cotter Joint
- Universal Coupling
- Screw Jack etc.

Total hours 45

PME402 MANUFACTURING TECHNOLOGY 3 0 0 3

Unit I THEORY OF METAL CUTTING 10

Material removal processes- types of machine tools – theory of metal cutting: chip formation, orthogonal metal cutting, cutting tool materials, tool wear, tool life, surface finish, cutting fluids.

Unit II CENTRE LATHE AND SPECIAL PURPOSE LATHES 10

Centre lathe, constructional features, cutting tools, various operations, taper turning methods, thread cutting methods, special attachments, machining time and power estimation.

Capstan and turret lathes – automatic lathes : semi automatic, automats – single spindle - cutting off, swiss type, automatic screw type – multi spindle-cutting off, bar type

Unit III RECIPROCATING AND MILLING MACHINES 10

Reciprocating machine tools- shaper, planer, slotter ; milling - types, milling cutters, operations - hole making - drilling, reaming, boring, tapping

Unit IV ABRASIVE PROCESS 8

Abrasive processes: grinding wheel – specifications and selection, types of grinding process – cylindrical grinding, surface grinding, centreless grinding – honing, lapping, super finishing, polishing and buffing, abrasive jet grinding

Unit V SAWING, BROACHING AND GEAR CUTTING 7

Sawing machine- hack saw, band saw, circular saw- broaching machines- broach construction – push, pull, surface and continuous broaching machines, gear cutting: forming, generation, shaping, hobbing.

TOTAL : 45

TEXT BOOKS

1. Rao, P.N. "Manufacturing Technology", Metal Cutting and Machine Tools, Tata McGraw-Hill, New Delhi, 2003.
2. Richerd R. Kibbe, John E. Neely, Roland O. Merges and Warren J. White, "Machine Tool Practices", Prentice Hall of India, 2003.

REFERENCES

1. HMT – "Production Technology", Tata McGraw-Hill, 1998.
2. P.C. Sharma, "A Text Book of Production Engineering", S. Chand and Co. Ltd, IV edition, 1993.
3. Hajra Choudry, "Elements of Work Shop Technology – Vol. II", Media Promoters. 2002
4. Geoffrey Boothroyd, "Fundamentals of Metal Machining and Machine Tools", McGraw Hill, 1984.

PME403 HEAT AND MASS TRANSFER 3 1 0 4
UNIT I CONDUCTION 11

Basic Concepts – Mechanism of Heat Transfer – Conduction, Convection and Radiation – General Differential equation of Heat Conduction – Fourier Law of Conduction – Cartesian and Cylindrical Coordinates – One Dimensional Steady State Heat Conduction – Conduction through Plane Wall, Cylinders and Spherical systems – Composite Systems – Conduction with Internal Heat Generation – Extended Surfaces – Unsteady Heat Conduction – Lumped Analysis – Use of Heislers Chart.

UNIT I I CONVECTION 10

Basic Concepts – Convective Heat Transfer Coefficients – Boundary Layer Concept – Types of Convection – Forced Convection – Dimensional Analysis – External Flow – Flow over Plates, Cylinders and Spheres – Internal Flow – Laminar and Turbulent Flow – Combined Laminar and Turbulent – Flow over Bank of tubes – Free Convection – Dimensional Analysis – Flow over Vertical Plate, Horizontal Plate, Inclined Plate, Cylinders and Spheres.

UNIT I II PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS 9

Nusselts theory of condensation-pool boiling, flow boiling, correlations in boiling and condensation. Types of Heat Exchangers – LMTD Method of heat Exchanger Analysis – Effectiveness – NTU method of Heat Exchanger Analysis – Overall Heat Transfer Coefficient – Fouling Factors.

UNIT I V RADIATION 8

Basic Concepts, Laws of Radiation – Stefan Boltzman Law, Kirchoff Law –Black Body Radiation –Grey body radiation Shape Factor Algebra – Electrical Analogy – Radiation Shields – Introduction to Gas Radiation.

UNIT V MASS TRANSFER 7

Basic Concepts – Diffusion Mass Transfer – Fick's Law of Diffusion – Steady state Molecular Diffusion – Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy – Convective Mass Transfer Correlations

LECTURE 45 TUTORIAL 15 TOTAL HOURS:60

Note: *(Use of standard heat and mass transfer data book is permitted in the University examination)*

TEXT BOOKS

1. Sachdeva R C, "Fundamentals of Engineering Heat and Mass Transfer" New Age International, 1995.
2. Yadav R "Heat and Mass Transfer" Central Publishing House, 1995.

REFERENCES

1. Ozisik M.N, "Heat Transfer", McGraw-Hill Book Co., 1994.
2. Nag P.K, " Heat Transfer", Tata McGraw-Hill, New Delhi, 2002
3. Holman J.P "Heat and Mass Transfer" Tata McGraw-Hill, 2000.
4. Kothandaraman C.P "Fundamentals of Heat and Mass Transfer" New Age International, New Delhi, 1998
5. Frank P. Incropera and David P. DeWitt, "Fundamentals of Heat and Mass Transfer", John Wiley and Sons, 1998.
6. Velraj R, "Heat & Mass Transfer", Ane Books, New Delhi, 2004

Unit I FORCE ANALYSIS 10

Rigid Body dynamics in general plane motion – Equations of motion - Dynamic force analysis - Inertia force and Inertia torque – D’Alemberts principle - The principle of superposition - Dynamic Analysis in Reciprocating Engines – Gas Forces - Equivalent masses - Bearing loads - Crank shaft Torque - Turning moment diagrams - Fly wheels –Engine shaking Forces - Cam dynamics - Unbalance, Spring, Surge and Windup.

Unit II BALANCING 9

Static and dynamic balancing - Balancing of rotating masses - Balancing a single cylinder Engine - Balancing Multi-cylinder Engines - Partial balancing in locomotive Engines - Balancing linkages - balancing machines

Unit III FREE VIBRATION 10

Basic features of vibratory systems - idealized models - Basic elements and lumping of parameters - Degrees of freedom - Single degree of freedom - Free vibration - Equations of motion - natural frequency - Types of Damping - Damped vibration critical speeds of simple shaft - Torsional systems; Natural frequency of two and three rotor systems.

Unit IV FORCED VIBRATION 6

Response to periodic forcing - Harmonic Forcing - Forcing caused by unbalance - Support motion – Force transmissibility and amplitude transmissibility - Vibration isolation.

Unit V MECHANISMS FOR CONTROL 10

Governors - Types - Centrifugal governors - Gravity controlled and spring controlled centrifugal governors –Characteristics - Effect of friction - Controlling Force - other Governor mechanisms.

Gyroscopes - Gyroscopic forces and Torques - Gyroscopic stabilization - Gyroscopic effects in Automobiles, ships and airplanes

LECTURE 45 TUTORIAL 15 TOTAL 60

TEXT BOOKS

1. Rattan S.S., "Theory of Machines", Tata McGraw-Hill Publishing Company Ltd., New Delhi, 1994.

REFERENCES

1. Thomas Bevan, "Theory of Machines", CBS Publishers and Distributors, 1984.
2. Ghosh A. and Mallick A.K., "Theory of Mechanisms and Machines", Affiliated East-West Press Pvt. Ltd., New Delhi, 1988.
3. Shigley J.E. and Uicker J.J., "Theory of Machines and Mechanisms", McGraw-Hill, Inc., 1995.
4. Rao J.S. and Dukkipati R.V., "Mechanism and Machine Theory ", Wiley-Eastern Limited, New Delhi, 1992.

LIST OF EXPERIMENTS

1. Thermal conductivity measurement by guarded plate method
2. Thermal conductivity of pipe insulation using lagged pipe apparatus
3. Natural convection heat transfer from a vertical cylinder
4. Forced convection inside tube
5. Heat transfer from pin-fin (natural & forced convection modes)
6. Determination of Stefan-Boltzmann constant
7. Determination of emissivity of a grey surface
8. Effectiveness of Parallel/counter flow heat exchanger

Total Hours: 45

LINEAR MODELS**9**

The phases of operations research study- Linear programming - Graphical method - Simplex algorithm - Duality- Transportation problems - Assignment problems - Applications to problems with discrete variables.

NETWORK MODELS**6**

Network models - Shortest route - Minimal spanning tree - Maximum flow models - Project network

CPM,PERT AND SEQUENCING MODELS**7**

CPM and PERT networks - Critical path scheduling - Sequencing models.

INVENTORY MODELS**8**

Inventory models - Economic order quantity models - Quantity discount models - Stochastic Inventory models - Multi product models - Inventory control models in practice.

QUEUEING THEORY**7**

Queueing models - Queueing systems and structures - Notation - parameter - Single Server and multi server models - Poisson input - Exponential service - Constant rate service - Infinite population - Simulation.

DECISION MODELS**8**

Decision models - Game theory - Two person zero sum games - Graphical solution - Algebraic solution – Linear programming solution - Replacement models - Models based on service life - Economic life - Single/ Multi variable search technique - Application of OR models - Case studies

TUTORIALS:15**Total No of periods: 60****Text Books:**

1. H.A.Taha, " Operations Research ", Prentice Hall of India, 1999, Sixth Edition.
2. S.Bhaskar, " Operations Research ", Anuradha Publishers, Tamil Nadu, 1999.

References:

1. Shennoy, Srivastava, " Operation Research for Management ", Wiley Eastern, 1994.
2. M.J. Bazara, Jarvis, H. Sherali, " Linear Programming and Network Flows ", John Wiley, 1990.
3. Philip and Ravindran, " Operational Research ", John Wiley, 1992.
4. Hillier and Lieberman, " Operations Research ", Holden Day, 1986.
5. Frank, S.Budnick, Dennis, McLeavy, " Principles of Operation Research for Management ", Richard D Irwin, 1990.

PME 502 ENGINEERING ECONOMICS AND COST ANALYSIS 3 0 0 3

INTRODUCTION TO ECONOMICS

8

Introduction to Economics- Flow in an economy, Law of supply and demand, Concept of Engineering Economics – Engineering efficiency, Economic efficiency, Scope of engineering economics- Element of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost, Break-even analysis- V ratio, Elementary economic Analysis – Material selection for product Design selection for a product, Process planning.

CASH FLOW

9

Methods of comparison of alternatives – present worth method (Revenue dominated cash flow diagram), Future worth method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), Annual equivalent method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), rate of return method, Examples in all the methods.

VALUE ENGINEERING

12

Make or buy decision, Value engineering – Function, aims, Value engineering procedure. Interest formulae and their applications –Time value of money, Single payment compound amount factor, Single payment present worth factor,

Equal payment series sinking fund factor, Equal payment series payment Present worth factor-equal payment series capital recovery factor-Uniform gradient series annual equivalent factor, Effective interest rate, Examples in all the methods.

REPLACEMENT AND MAINTENANCE ANALYSIS

9

Replacement and Maintenance analysis – Types of maintenance, types of replacement problem, determination of economic life of an asset, Replacement of an asset with a new asset – capital recovery with return and concept of challenger and defender, Simple probabilistic model for items which fail completely.

DEPRECIATION

7

Depreciation- Introduction, Straight line method of depreciation, declining balance method of depreciation-Sum of the years digits method of depreciation, sinking fund method of depreciation/ Annuity method of depreciation, service output method of depreciation-Evaluation of public alternatives- introduction, Examples, Inflation adjusted decisions – procedure to adjust inflation, Examples on comparison of alternatives and determination of economic life of asset.

TOTAL : 45

TEXT BOOKS

- 1.Panneer Selvam, R, “Engineering Economics”, Prentice Hall of India Ltd, New Delhi, 2001.
2. Lawrence and Mile., “Value Engineering”

REFERENCES

Chan S.Park, “Contemporary Engineering Economics”, Prentice Hall of India, 2002.
Donald.G. Newman, Jerome.P.Lavelle, “Engineering Economics and analysis” Engg. Press, Texas, 2002

Degarmo, E.P., Sullivan, W.G and Canada, J.R, “Engineering Economy”, Macmillan, New York, 1984
Grant.E.L., Ireson.W.G., and Leavenworth, R.S, “Principles of Engineering Economy”, Ronald Press, New York,1976.

Smith, G.W., “Engineering Economy”, Iowa State Press, Iowa, 1973.

INTRODUCTION TO POWER PLANTS & BOILERS**7**

Layout of Steam, Hydel, Diesel, MHD, Nuclear and Gas Turbine Power Plants - Combined Power Cycles – Comparison and Selection, Load Duration Curves-Steam Boilers and Cycles – High Pressure and Super Critical Boilers – Fluidised Bed Boilers

STEAM POWER PLANT**8**

Components of Steam Generators, Fuel and Ash Handling, Combustion Equipment for burning coal, Mechanical Stokers, Pulveriser, Electrostatic Precipitator, Draught – different types, Condenser Types, Cooling Towers, Chimney, Feed Water Quality, Deaerator,

NUCLEAR , HYDEL AND DIESEL POWER PLANTS**15**

Nuclear Energy – Fission, Fusion Reaction, Types of Reactors, pressurized water reactor, Boiling Water Reactor, Waste Disposal and safety.

Hydel Power Plant – Essential Elements, Selection of Turbines, Governing of Turbines- Micro Hydel developments.

Types of Diesel Plants, Components, Selection of Engine Type, Applications

GAS TURBINE AND OTHER POWER PLANTS**8**

Gas Turbine Power Plant – Fuels - Gas Turbine Material – Open and Closed Cycles – Reheating – Regeneration and Intercooling – Combined Cycle. Geo thermal –OTEC – Tidel - Pumped storage - Solar thermal central receiver system

ECONOMICS OF POWER PLANTS**7**

Cost of Electric Energy – Fixed and operating Costs – Energy Rates – Types of Tariffs – Economics of load sharing, comparison of economics of various power plants, Energy Losses.-Case Studies

TOTAL : 45**TEXT BOOKS**

1. Arora S.C and Domkundwar S, “A course in Power Plant Engineering”, Dhanpatrai, 2001.
2. Nag P.K, “Power plant Engineering”, Tata McGraw-Hill, 1998.
3. R.K.Rajput, “Power Plant Engineering”, Laxmi Publications, 1995.

REFERENCES

1. EI- Wakil M.M, “Power Plant Technology”, McGraw-Hill 1984.
2. G.R. Nagpal, “Power Plant Engineering”, Hanna Publishers, 1998.
3. K.K.Ramalingam, “Power Plant Engineering”, Scitech Publications, 2002.
4. G.D.Rai, “Introduction to Power Plant Technology”, Khanna Publishers, 1995.
5. Frank D.Graham “Power Plant Engineers Guide”, D.B. Taraporevala Sons & Co, New Delhi, 1993.
6. T.Morse Frederick, “Power Plant Engineering”, Prentice Hall of India, 1998

MECHATRONICS, SENSORS AND TRANSDUCERS**8**

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

ACTUATION SYSTEMS**7**

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.

SYSTEM MODELS AND CONTROLLERS**8**

Building blocks of Mechanical, Electrical, Fluid and Thermal Systems, Rotational – Transnational Systems, Electromechanical 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.

PROGRAMMING LOGIC CONTROLLERS**7**

Programmable Logic Controllers – Basic Structure – 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 Problem.

DESIGN OF MECHATRONICS SYSTEM**15**

Stages in designing Mechatronics Systems – Traditional and Mechatronic Design - Possible Design Solutions Case Studies of Mechatronics Systems, Robotics-Pick and place robot – automatic Car Park Systems – Engine Management Systems.

Introduction - Fuzzy Logic and Neural Networks-Applications

TOTAL : 45**TEXT BOOKS**

1. W. Bolton, “Mechatronics”, Pearson Education, Second Edition, 1999.

REFERENCES

1. Michael B. Histan and David G. Alciatore, “ Introduction to Mechatronics and Measurement Systems”, McGraw-Hill International Editions, 2000.
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

Exercises

1. Metal Cutting Experiments

Shaping Operations

Slotting Operations

Radial Drilling

Cylindrical Grinding

Surface Grinding

Gear Cutting- Horizontal Milling Machine

Keyway Slot Outer – Vertical Milling Machine

2. CNC Machines-Lathe

(Example: CNC Programming -Manual and Part Programming, CNC Tooling, CNC Machining etc.)

TOTAL : 45

**PME 601 MATERIALS MANAGEMENT AND INDUSTRIAL ENGINEERING 3 0 0
3**

15

Materials Management, Purchase and Stores Management: Inventory control, Material Handling.
Industrial Management: Principles and functions of Management: Management Concepts,
Leadership and decision making,

15

Human resources: personnel management, industrial legislation and relations, industrial
psychology, manpower planning, training and development, health, safety, welfare, remuneration
and incentive schemes.

Financial Management, Sales and Marketing Management. Cost Accounting and Control,
Budget and Budgetary control.

15

Plant Layout, Location and Line Balancing, Process Planning and Group Technology,
Production planning and control

Text Book

1. *Productions and Operations Management* by A.Muhlemann, J.Oakland and K.Lockyer, Macmillan.
2. *Industrial Engineering and Management* by O.P.KHANNA

References :

1. *Production Systems: Planning, Analysis and Control* by J.L.Riggs, 3rd ed., Wiley.

VEHICLE STRUCTURE AND ENGINES

9

Types of Automobiles - Vehicle Construction – Chassis – Frame and Body –aerodynamics. Components of Engine – Their forms, Functions and Materials - Review of Cooling and Lubrication systems in Engine – Turbo Chargers – Engine Emission Control by 3–Way Catalytic Controller – Electronic Engine Management System.

ENGINE AUXILIARY SYSTEMS

6

Carburetor–working principle- Electronic fuel injection system – Mono-point and Multi - Point Injection Systems – Construction, Operation and Maintenance of Lead Acid Battery

ENGINE ELECTRICAL SYSTEMS

6

Electrical systems – Battery generator – Starting Motor and Drives – Lighting and Ignition (Battery, Magneto Coil and Electronic Type)-Regulators-cut outs.

TRANSMISSION SYSTEMS

9

Clutch – Types and Construction – Gear Boxes, Manual and Automatic – Simple Floor Mounted Shift Mechanism – Over Drives – Transfer Box Fluid flywheel-Torque convertors– Propeller shaft – Slip Joint – Universal Joints – Differential and Rear Axle – Hotchkiss Drive and Torque Tube Drive

STEERING, BRAKES AND SUSPENSION

10

Wheels and Tyres – Wheel Alignment Parameters - Steering Geometry and Types of steering gear box– Power Steering – Types of Front Axle – Suspension systems – Braking Systems – Types and Construction – Diagonal Braking System – Antilock Braking System.

ALTERNATIVE ENERGY SOURCES

5

Use of Natural Gas, LPG, Biodiesel, Gasohol and Hydrogen in Automobiles - Electric and Hybrid Vehicles, Fuel Cells.

Note: Practical training in dismantling and assembling of Engine parts Transmission System should be given to the students

TOTAL : 45

TEXT BOOKS

1. Sethi H.M, “Automobile Technology”, Tata McGraw-Hill-2003
2. Kirpal Singh “Automobile Engineering Vol. 1& 2”, Standard Publishers, New Delhi.

REFERENCES

1. Crouse and Anglin “Automotive Mechanism”, 9th Edition. Tata McGraw-Hill, 2003.
2. Newton, Steeds and Garet, “Motor vehicles”, Butterworth Publishers, 1989.
3. .Srinivasan.S , “ Automotive Mechanics” 2nd edition, 2003, Tata McGraw-Hill.
4. Joseph Heitner, “Automotive Mechanics”, 2nd edition, East-West Press, 1999.

Studies of working principles and operations of:

1. Engine Systems.
2. Fuels supply systems:
3. Clutches.
4. Transmission systems.
5. Drive Lines & Differentials.
6. Suspension Systems.
7. Steering Systems.
8. Tyres & wheels.
9. Braking systems.
10. Hydraulic Systems
11. Computer aided Modeling of any two Transmission systems
12. Crash worthiness of the designed frame using Hypermesh and LS-Dyna solver.

15

Origin Of Caste and Race

- (a) India: A nation of caste and class
- (b) Caste and Race: Dravidian and Aryan conflict-An Historical Overview

Anti-caste and race movement in modern India

- (a) Anti-caste struggles in Modern India: Mahatma Phule's contribution

15

Eradication of Caste and Race Discrimination Periyar Ramasamy Naicker 's new initiatives.

Abolition of Untouchability and caste

Ambedhkar 's Approach to Eradication of untouchability and Annihilation of caste in the context of Dalit Movement in India.

15

Labour, Caste and women

- (a) Dignity of Labour and caste: Kancha Illaiah's Scientific Method
- (b) Women and caste :Issues of Men –Women of Equality

Technical Education in India

- (a) Understanding Science and Society
- (b) Engineering the society Towards Equality and Growth.

Text Books

1. Dr. B. R. Ambedhkar and Untouchability-fighting the Indian caste system-Christophe, Jattrelot, Coluia University Press, May 2005.
2. Collected Works of Periyar EVR, Compiled by Dr. K. Veeramani, the Periyar Self-respect Propoganda Institution PERIYAR Thidal, 50. EVK Sampath Salai, Chennai-600 007.
3. Mahatma Jothipa Phule Life History .
4. Dignity of Labour in our time , Prof. Kanch Illaiah ,Hydrebad.
5. Dravidian and Aryan conflict .

The objective of the project work is to enable the students in convenient groups of not more than 4 members on a project involving theoretical and experimental studies related to the branch of study. Every project work shall have a guide who is the member of the faculty of the institution. Six periods per week shall be allotted in the time table and this time shall be utilized by the students to receive the directions from the guide, on library reading, laboratory work, computer analysis or field work as assigned by the guide and also to present in periodical seminars on the progress made in the project.

Each student shall finally produce a comprehensive report covering background information, literature survey, problem statement, project work details and conclusion. This final report shall be typewritten form as specified in the guidelines.

The continuous assessment shall be made as prescribed in the regulations.

REFRIGERATION CYCLE**9**

Review of thermodynamic principles of refrigeration. Concept of Aircraft refrigeration system. Vapour compression refrigeration cycle - use of P-H charts - multistage and multiple evaporator systems - cascade system - COP comparison. Vapor absorption refrigeration system. Ammonia water and Lithium Bromide water systems. Steam jet refrigeration system.

REFRIGERANTS, SYSTEM COMPONENTS**6**

Compressors - reciprocating & rotary (elementary treatment.) - condensers - evaporators - cooling towers. Refrigerants - properties - selection of refrigerants, Alternate Refrigerants, Refrigeration plant controls - testing and charging of refrigeration units.

BALANCING OF SYSTEM COMPONENTS**6**

Balancing of system components. Applications to refrigeration systems - ice plant - food storage plants - milk -chilling plants – refrigerated cargo ships.

PSYCHROMETRY**9**

Psychrometric processes- use of psychrometric charts - Grand and Room Sensible Heat Factors - bypass factor - requirements of comfort air conditioning - comfort charts - factors governing optimum effective temperature, recommended design conditions and ventilation standards.

COOLING LOAD CALCULATIONS**8**

Types of load - design of space cooling load - heat transmission through building. Solar radiation - infiltration - internal heat sources (sensible and latent) - outside air and fresh air load - estimation of total load - Domestic, commercial and industrial systems - central air conditioning systems.

AIRCONDITIONING**7**

Air conditioning equipments – air cleaning and air filters - humidifiers - dehumidifiers - air washers - condenser – cooling tower and spray ponds - elementary treatment of duct design - air distribution system. Thermal insulation of air conditioning systems. - applications: car, industry, stores, and public buildings

TOTAL : 45**Text Books**

1. Manohar Prasad, "Refrigeration and Air Conditioning", Wiley Eastern Ltd., 1983.
2. Arora. C.P., "Refrigeration and Air Conditioning", Tata McGraw-Hill New Delhi, 1988.

REFERENCES

1. Roy.J Dossat, "Principles of Refrigeration", Pearson Education 1997.
2. Jordon and Prister, "Refrigeration and Air Conditioning", Prentice Hall of India PVT Ltd., New Delhi, 1985.
3. Stoecker N.F and Jones, "Refrigeration and Air Conditioning", TMH, New Delhi, 1981.

FLUID POWER SYSTEMS AND FUNDAMENTALS**9**

Introduction to fluid power, Advantages of fluid power, Application of fluid power system. Types of fluid power systems, Properties of hydraulic fluids – General types of fluids – Fluid power symbols. Basics of Hydraulics-Applications of Pascals Law- Laminar and Turbulent flow – Reynold's number – Darcy's equation – Losses in pipe, valves and fittings.

HYDRAULIC SYSTEM**6**

Sources of Hydraulic Power: Pumping theory – Pump classification – Gear pump, Vane Pump, piston pump, construction and working of pumps – pump performance – Variable displacement pumps.

HYDRAULIC SYSTEM COMPONENTS**6**

Fluid Power Actuators: Linear hydraulic actuators – Types of hydraulic cylinders – Single acting, Double acting special cylinders like tandem, Rodless, Telescopic, Cushioning mechanism, Construction of double acting cylinder, Rotary actuators – Fluid motors, Gear, Vane and Piston motors.

DESIGN OF HYDRAULIC CIRCUITS**9**

Construction of Control Components : Director control valve – 3/2 way valve – 4/2 way valve – Shuttle valve – check valve – pressure control valve – pressure reducing valve, sequence valve, Flow control valve – Fixed and adjustable, electrical control solenoid valves, Relays, ladder diagram. Accumulators and Intensifiers : Types of accumulators – Accumulators circuits, sizing of accumulators, intensifier – Applications of Intensifier – Intensifier circuit.

PNEUMATIC SYSTEMS AND COMPONENTS**8**

Pneumatic Components: Properties of air – Compressors – Filter, Regulator, Lubricator Unit – Air control valves, Quick exhaust valves, pneumatic actuators. Fluid Power Circuit Design, Speed control circuits, synchronizing circuit, Pneumo hydraulic circuit, Sequential circuit design for simple applications using cascade method.

DESIGN OF PNEUMATIC CIRCUITS**7**

Servo systems – Hydro Mechanical servo systems, Electro hydraulic servo systems and proportional valves. Fluidics – Introduction to fluidic devices, simple circuits, Introduction to Electro Hydraulic Pneumatic logic circuits, ladder diagrams, PLC applications in fluid power control. Fluid power circuits; failure and troubleshooting.

TOTAL : 45**TEXT BOOKS**

1. Anthony Esposito, "Fluid Power with Applications", Pearson Education 2000.
2. Majumdar S.R., "Oil Hydraulics", Tata McGraw-Hill, 2000.

REFERENCES

1. Majumdar S.R., "Pneumatic systems – Principles and maintenance", Tata McGraw Hill, 1995
2. Anthony Lal, "Oil hydraulics in the service of industry", Allied publishers, 1982.
3. Harry L. Stevart D.B, "Practical guide to fluid power", Taraoeala sons and Port Ltd. Broadey, 1976.
4. Michael J, Prinches and Ashby J. G, "Power Hydraulics", Prentice Hall, 1989.
5. Dudelyt, A. Pease and John T. Pippenger, "Basic Fluid Power", Prentice Hall, 1987.

Unit I**15**

Steam Power Plant : Solid, liquid and gaseous fuels, storage and preparation of fuels, fuel bed firing, combustion conditions, suspension firing, draft systems. Steam generators and their types, circulation principles, forced circulation boilers, water walls, mountings, and accessories, performance rating of boilers, Feed water conditioning, Fuel and ash handling equipment, dust collectors. Condenser cooling water system.

Unit II**15**

Steam pipes, pipe fittings, lagging, air and gas ducts. Instrumentation and control of steam power plant. Diesel Power Plant: Equipment of diesel plants, field of applications, fuel - storage and handling, cooling systems.

Unit III**15**

Nuclear Power Plant: Introduction to nuclear power, types of reactors, heat release rates, steam generation principles. Use of renewable energy - utilisation of solar, wind, tidal, geothermal resources. Hydroelectric power plants. Plant economy : Load curve, load factor, capacity factor, utilization factor etc. Investment cost, fixed and annual operating costs, unit cost, tariff, influence of station performance characteristics on costs. Selection and location of plants, comparative study of different plants.

References :

- 1. Power Plant Engineering by M.M. Elwakil, Tata McGraw Hill*
- 2. Power Plant Engineering by P.K. Nag, Tata McGraw Hill*
- 3. Power Plant Engineering by Domkundwar, Dhanpat Rai*

INTRODUCTION**6**

Amorphous, crystalline, microcrystalline, quasi-crystalline and nano-crystalline materials. Historical development of nanomaterials – Issues in fabrication and characterization of nanomaterials

SYNTHESIS**9**

Methods of production of Nanoparticles-Top down and Bottom up approach, Sol-gel synthesis, Inert gas condensation, High energy Ball milling, Plasma synthesis, Electro deposition and other techniques. Synthesis of Carbon Nanotubes – Solid carbon source based production techniques, Gaseous carbon source based production techniques - Growth mechanisms, Nano wires.

CHARACTERISATION TECHNIQUES**15**

Scanning Probe Microscopy (SPM) – Scanning tunneling microscope, Transmission electron microscope, Scanning transmission electron microscope, Atomic force microscope, Scanning force microscopy, Electrostatic force microscopy, Dynamic force microscopy, Magnetic force microscopy, Scanning thermal microscopy, Piezo force microscopy, scanning capacitance microscopy, Nano indentation.

NANO FABRICATION AND MACHINING**9**

LIGA, Ion beam etching, Molecular manufacturing techniques – Nano machining techniques –, Top/Bottom up Nano fabrication techniques - Sub micron lithographic technique, conventional film growth technique, Chemical etching, Quantum materials.

APPLICATIONS**6**

Applications in Mechanical, Electronics engineering industries – Use of nanomaterials in automobiles, aerospace, defense and medical applications – Metallic, polymeric, organic and ceramic nanomaterials.

TEXT BOOKS:

1. A.K. Bandyopadhyay, “Nano Materials”, New Age International Publishers, New Delhi, 2007
2. Bharat Bhushan, “Handbook of Nanotechnology”, Springer, Germany, 2004.

REFERENCES:

1. Mark Ratner and Daniel Ratner, “Nano Technology”, Pearson Education, New Delhi, 2003.
2. Gregory Timp, “Nanotechnology”, Springer, India, 2005
3. Ahmed Busnaina, “Nanomanufacturing Handbook”, CRC Press, London, 2006.

CONVENTIONAL POWER GENERATION**12**

Steam power plant - Selection of site - Generated Layout - coal and Ash Handling -Steam Generating Plants - Feed Make Circuit - Cooling Towers - Turbine Governing -Hydro Power Plant-Selection of Site - Classification Layout Governing of Turbines -Nuclear Power Plants - Selection of Site - Classification Layout Governing of Turbines - Nuclear Power Plants - Selection of Site - Nuclear Fuels - Nuclear reactors - Nuclear disposal - Gas Turbine Plants.

NON CONVENTIONAL POWER GENERATION**9**

Wind power generation - characteristics of wind power-design of windmills - Tidal power generation - Single and two-basin systems Turbines for tidal power - Solar power generation - Energy from biomass, biogas and waste

ECONOMICS OF POWER GENERATION**7**

Daily load curves - load factor - diversity factor - load deviation curve - load management - number and size of generating unit, cost of electrical energy – tariff - power factor improvement

ELECTRICAL POWER TRANSMISSION**9**

Online diagram of transmission - substation and distribution systems - comparison of systems (DC and AC) - EHVAC and HVDC transmission - layout of substations and bus bar arrangements - Equivalents circuit of short, medium and long lines -Transmission efficiency-regulation-reactive power - compensation-transmission - loss minimization

UTILISATION OF ELECTRICAL ENERGY**8**

Selection of Electrical Drives - Electrical characteristics and mechanical considerations -size, rating and cost, Transformer characteristics – illumination - laws of illumination-polar curve - incandascant-fluoroscent and vapour lamps - Design of OLTC lighting Scheme of industry-electrical welding - energy efficient aspects of devices

REFERENCES:

1. C.L.Wadhwa, Generation Distribution and utilization of Electrical Energy, Wiley Eastern Ltd., India(1989)
2. V.A.Venikov and B.V. Put Yatin, Introduction of Energy Technology, Electric power Engineering, MIR Publishers, Moscow(1984)
3. M.L.Soni,P.VGupta and V.S.A.Bhatnagar, Course in Electrical Power, Dhanbat Rai & Sons, NewDelhi(1983)
4. J.W.Twidell and A.D.Weir, Renewable Energy Sources, ELBS Edition(1986)
5. A.J.Wood and B.F. Wallenberg(1986):Power Generation, Operation and Control,2nd Edition, JohnWiley &Sons, Newyork
6. E.Khan(1988):Electrical Utility Planning and Regulation, American Council for a n Energy Efficient Economy, Washington *D.C*

15

Spark Ignition Engines, mixture requirements – Fuel – Injection systems – Monopoint, Multipoint injection, Direct injection – Stages of combustion – Normal and abnormal combustion – factors affecting knock – Combustion chambers.

Compression ignition engines, Stages of combustion in C.I. Engine – Direct and indirect injection systems –

15

Combustion chambers – Fuel spray behaviour – spray structure, spray penetration and evaporation – air motion – Introduction to Turbo charging and supercharging.

Combustion modeling, Basic concepts of engine simulation, governing equations, simulation of various engine processes for SI and CI Engines. Thermodynamic and fluid mechanic based models.

15

Alternative fuels, Alcohol, Hydrogen, Natural Gas Bio diesel, fuel cell. Other possible fuels and Liquefied Petroleum Gas- Properties, Suitability, Merits and Demerits as fuels, Engine Modifications. Dual fuel operation

Recent trends, Lean Burn Engines – Stratified charge Engines – homogeneous charge compression ignition engines – Plasma Ignition – Zero Emission Vehicles, Engines for special applications – Mining, Defence, Off-highway -Tractor, Bulldozer etc. Submarines, Race car Engine systems, Flexible fuel systems. Surface ignition,

Total Hours - 45hrs

REFERENCES

- 1 *K.K. Ramalingam, Internal Combustion Engine Fundamentals, Scitech Publications, 2002.*
- 2 *John B Heywood, Internal Combustion Engine Fundamentals, McGraw Hill*
- 3 *M.L. Mathur and R.P.Sharma, A course in internal Combustion Engines, Dhanapat Rai Publications, New Delhi.*
- 4 *R.B.Mathur and R.P. Sharma, Internal combustion Engines.*
- 5 *V. Ganesan, Int. Combustion Engines, II Edition, TMH, 2002.*
- 6 *Duffy Smith, Auto fuel Systems, The Good Heart Willox Company, Inc.*
- 7 *Ganesan V. Computer simulation of spark ignition process: University process. Hyderabad 1993.*
- 8 *Ganesan V. Computer simulation of compression ignition engine. Orient Long man 2000.*

INTRODUCTION

8

Systems, modeling, general systems theory, concept of simulation, simulation as a decision making tool, types of simulation.

RANDOM NUMBERS AND VARIATES

8

Pseudo random numbers, methods of generating random variates, testing of random numbers and variants.

DESIGN OF SIMULATION EXPERIMENTS

9

Problem formulation, data collection and reduction, time flow mechanism, key variables, logic flow chart, starting condition, run size, experimental design consideration, output analysis and interpretation validation.

SIMULATION LANGUAGES

7

Comparison and selection of simulation languages, study of any one simulation language.

CASE STUDIES / MINI PROJECT

13

Development of simulation models using the simulation language studied for systems like, queuing systems, production systems, inventory systems, maintenance and replacement systems, investment analysis and network.

REFERENCES:

1. *Jerry Banks and John S.Carson, Barry L Nelson, David M.Nicol, P.Shahabudeen,*
2. *Discrete event system simulation, Pearson Education, 2007.*
3. *Law A.M, Simulation Modelling and Analysis, Tata Mc Graw Hill,2008*
4. *Thomas J.Schriber, Simulation using GPSS, John Wiley, 1991.*
5. *Kelton, W. David, Simulation with Arena ,McGraw-Hill,2006*

GOVERNING EQUATIONS AND BOUNDARY CONDITIONS**9**

Basics of computational fluid dynamics – Governing equations of fluid dynamics – Continuity, momentum and Energy equations – Chemical species transport – Physical boundary conditions – Time-averaged equations for Turbulent flow - Turbulence -Kinetic -Energy Equations – mathematical behavior of PDEs on CFD: Elliptic, Parabolic and Hyperbolic equations.

DISCRETIZATION**6**

Methods of Deriving the Discretization Equations - Taylor Series formulation – Finite difference method – Control volume Formulation – Spectral method.

SOLUTION METHODOLOGIES**6**

Solution methodologies: Direct and iterative methods, Thomas algorithm, Relaxation method, Alternating Direction Implicit method.

HEAT CONDUCTION**9**

Finite difference and finite volume formulation of steady/transient one-dimensional conduction equation, Source term linearization, Incorporating boundary conditions, Finite volume formulations for two and three dimensional conduction problems

CONVECTION AND DIFFUSION**8**

Finite volume formulation of steady one-dimensional convection and Diffusion problems, Central, upwind, hybrid and power-law schemes - Discretization equations for two dimensional convection and diffusion.

CALCULATION OF FLOW FIELD**7**

Representation of the pressure - Gradient term and continuity equation - Staggered grid - Momentum equations - Pressure and velocity corrections - Pressure - Correction equation, SIMPLE algorithm and its variants. Turbulence models: mixing length model, Two equation (k- ϵ) models.

TEXT BOOKS

1. Versteeg, H.K, and Malalasekera, W., “An Introduction to Computational Fluid Dynamics: The Finite Volume Method”, Longman, 1998.
2. Ghoshdastidar, P.S., "Computer Simulation of flow and heat transfer", Tata McGraw-Hill Publishing Company Ltd., 1998.

REFERENCES

1. Patankar, S.V., “Numerical Heat Transfer and Fluid Flow”, McGraw-Hill, 1980. Ane-Books2004 Indian Edition.
2. Muralidhar, K and Sundarajan .T., “Computational Fluid Flow and Heat Transfer”, Narosa Publishing House, New Delhi, 1995.3. Bose, T.K., “Numerical Fluid Dynamics”, Narosa publishing House, 1997.
4. Muralidhar, K and Biswas “Advanced Engineering Fluid Mechanics”, Narosa Publishing House, New Delhi, 1996.
5. Anderson, J.D., “Computational fluid dynamics – the basics with applications”, 1995.

INTRODUCTION & ONE-DIMENSIONAL PROBLEMS**12**

Relevance of finite element analysis in design - Variational principles and methods – Weighted-Integral statements – Weak formulations – Ritz method – Method of weighted residuals – Applications of FEA - Finite element modeling – Co-ordinates and shape functions - Potential energy approach – Galerkin’s approach – One dimensional finite element models in Solid mechanics and Heat transfer – Finite element model for beams

TWO-DIMENSIONAL PROBLEMS**9**

Poisson equation – Laplace equation – Weak form – Element matrices for triangular and rectangular elements – Evaluation of integrals – Assembly – Axi-symmetric problems – Applications Conduction and convection heat transfer - Torsional cylindrical member –Transient analysis - Theory of elasticity – Plane strain – Plane stress – Axi-symmetric problems – Principle of virtual displacement

ISOPARAMETRIC ELEMENTS**7**

Introduction – Bilinear quadrilateral elements – Quadratic quadrilaterals – Hexahedral elements - Numerical integration – Gauss quadrature – Static condensation – Load considerations – Stress calculations – Examples of 2D and 3D applications

STRUCTURAL DYNAMICS APPLICATIONS**9**

Dynamic equations – Mass and damping matrices – Natural frequencies and modes – Reduction of number of DOF-response history – Model methods – Ritz vectors – Component mode synthesis – Harmonic response – Direct integration techniques – Explicit and implicit methods – Analysis by response spectra – Example problems

NON-LINEAR PROBLEMS & ERROR ESTIMATES**8**

Introduction – Material non-linearity – Elasto Plasticity – Plasticity – Visco plasticity – Geometric non-linearity – Large displacement – Error norms and convergence rates – refinement with adaptivity – adaptive refinement

REFERENCES

1. Reddy J.N., “An Introduction to the Finite Element Method”, McGraw Hill, International Edition, 1993.
2. Logan D.L., “A First Course in the Finite Element Method”, Third Edition, Thomson Learning, 2002.
3. Cook, Robert Davis et al “Concepts and Applications of Finite Element Analysis”, Wiley, John & Sons, 1999.
4. Segerlind L.J., “Applied Finite Element Analysis”, John Wiley, 1984.
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6. Zienkiewicz, O.C. and Taylor, R.L., “The Finite Element Method”, Fourth Edition, Volumes 1 & 2, McGraw Hill International Edition, Physics Services, 1991.
7. Bathe K.J., “Finite Element Procedures in Engineering Analysis”, Prentice Hall, 1990

FUNDAMENTAL OF MANUFACTURING AND AUTOMATION**15**

Manufacturing operations and automation strategies; Hard and soft automation. Transfer systems, automated flow lines, feeders, assembly and line balancing. Adaptive control, Manual part programming through simple examples; computer assisted part programming. Automated storage and materials handling systems, Automated materials handling (including AGV), storage and retrieval systems; Robots and its applications in manufacturing.

LEAN MANUFACTURING AND SIX SIGMA**15**

Objectives of lean manufacturing-key principles and implications of lean manufacturing-traditional Vs lean manufacturing. Six sigma: Introduction- definition-methodology- impact of implementation of six sigma-DMAIC method-roles and responsibilities –leaders, champion, black belt, green belts.

INTRODUCTION TO JUST IN TIME MANUFACTURING AND AGILE MANUFACTURING**15**

Introduction - elements of JIT – uniform production rate - pull versus push method- Kanban system - small lot size - quick, inexpensive set-up - continuous improvement. Optimized production technology. Introduction –elements of AMT-objectives of AMT.

REFERENCES:

1. *Automation, Production Systems, & CIM* by Grover; Prentice Hall
2. *CAD CAM* by C. McMahon and J. Browne; published by Addison-Wesley.
3. *Agile Manufacturing* by A. Gunsekaran; Elsevier
4. *Computer Integrated Manufacturing and Engineering* by V. Rembold, B. O. Nanji and A. Storr; Addison-Wesley.
5. *De Feo J A and Barnard W W, "Six Sigma: Breakthrough and Beyond", Tata McGraw-Hill, New Delhi, 2005.*
6. *Modern Production/ Operations Management, E. S. Buffa and R. K. Sarin, John Wiley International, 1994.*
7. *Askin R G and Goldberg J B, "Design and Analysis of Lean Production Systems", John Wiley and Sons Inc., 2003.*
8. *Michael L George, David T Rowlands, Bill Kastle, "What is Lean Six Sigma", McGraw-Hill, New York, 2004.*
9. *Micheal Wader, "Lean Tools: A Pocket Guide to Implementing Lean Practices", Productivity and Quality Publishing Pvt Ltd, 2002.*

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Reliability: Definition and basic concepts; Failure data, failure modes, and reliability in terms of hazard rate and failure density function; Hazard models and bath tub curve; applicability of Weibull distribution. Reliability calculations for series, parallel and parallel-series systems; Reliability calculations for maintained and stand-by systems.

Maintenance - its role and scope in total organisational context. Objectives and characteristics of maintenance; basic guidelines for design of organisation structure for maintenance; Centralised vs decentralised maintenance;

15

Types of maintenance - corrective, planned, preventive and predictive maintenance; Factors affecting maintenance; opportunistic maintenance; Measurement of maintenance work; rating and allowances. Maintenance cost budgets. Maintenance planning and scheduling; MIS in maintenance; Measurement of maintenance effectiveness and maintenance audit. Applied Reliability -Reliability Testing, Reliability and Human Engineering , Reliability Management

15

Advanced Maintenance Theory -Inspection(Surveillance) Policies -Failure Diagnosis
Markov Maintenance Process

Basic laws of probability, Conditional probability, Random variable, sample distribution, statistical hypothesis, statistical tests of significance, correlation, regression analysis, autocorrelation, ANOVA, concept of reliability, availability and maintainability (RAM), systems reliability, reliability improvement, design of maintenance systems, spare parts management, Decision Support System, SWOT.

Reference :

1. Mechanical Reliability Engineering by ADS Carter, Macmilan
2. Reliability Evaluation of Engineering Systems by Roy Billington and R.N. Allen, Pitman
3. Introduction to Reliability Engineering by Dhilan & Singh
4. Reliabilities for the Technologies by L.A.Doty, Industrial Press Inc.
5. Kyung S. Park Reliability and Maintenance Engineering (Korean)

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Introduction of tribology- introduction –regimes of lubrication-layout of the books- references-Nature of the rough surfaces-introduction-surface roughness –measurement of surface texture-Types of engineering surface –Mathematical representation surface features-analogue solutions-Discrete interval solutions of profile height- Statistical representation surface texture- Worked examples-closure- references

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Elastic solids in normal contact-Introduction –deformation characteristics-Surface deformation in spherical contact-various contact geometries. -Line or circular footprint contacts-elliptical footprint contact- Worked examples-Onset of Yield-Cylindrical surfaces-spherical surfaces.-Nominally flat rough surfaces in contact-Idealized rough surfaces-Contact between real rough surfaces-Plasticity index-Fully Plastic surface contact- Worked examples-Contact between curved rough surfaces-Hertzian impact- closure-Appendices references-Dry friction and wear – Introduction- The basic mechanism of dry friction-Adhesion and deformation-adhesive friction-Influence of contaminant films-Deformation friction-Elastic rolling friction-Tractive rolling of an elastic cylinder-Creep ratio-Other examples of rolling friction-Thermal effects of a frictional temperature rise in concentrated contacts-wear of surfaces-Adhesive wear-Abrasive wear-Macroscopic sliding fatigue wear-corrosive wear-Fretting corrosion-closure-references

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Lubricant properties-Introduction-Dynamic viscosity-Effect of temperature on viscosity-The American society for testing materials (A.S.T.M Chart)-viscosity index of lubricants (VI)-Polymer Thickened Oils-Blends of Oils-Grades of oil-Effect of pressure on viscosity-Lubricant density-Effect of shear rate on viscosity-Worked example-Closure

The Reynolds and energy equations-introduction-Reynolds equation-Dimensional Analysis-Derivation of Reynolds equation in three dimensions-Equilibrium of forces on a lubricant element-velocity distribution-mass continuity-Simplification of Reynolds Equation-Long bearing-long bearing approximation for rigid cylinders-line contact pressure distribution-long contact load-narrow bearing-Squeeze film bearings-Rolling contacts- The energy equation-Significance of terms in the energy equation-convected heat only.

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1. *Tribology - a System Approach to the Science and Technology of Friction, Lubrication and Wear* by Horst Czichos, Elsevier Scientific Publishing Co.
2. *Principles of Tribology* by Halling J. (Editor), Macmillan, London.
3. *Handbook of Tribology: Materials, Coatings and Surface Treatments* by Bharath Bhooshan and B. K. Gupta, McGrawhill, New York.