BIJU PATNAIK UNIVERSITY OF TECHNOLOGY

MECHANICAL ENGINEERING

3rd Semester

Theory	*Contact Hrs.* L-T-P	*Credit*
BSCM1205 Mathematics - III	3-1-0	4
PCME4201 Fluid Mechanics & Hydraulic Machine	3-1-0	4
PCME4202 Mechanics of Solids	3-0-0	3
PCME4203 Introduction to Physical Metallurgy & Engg Materials	3-1-0	4
HSSM3204 Engineering Economics & Costing OR HSSM3205 Organizational Behaviour	3-0-0	3
BECS2208 Data Base Management Systems (DBMS)	3-0-0	3
Theory Credits		**21**

Practicals/Sessionals	*Contact Hrs.*	*Credit*
PCME7201 Machine Drawing	0-0-3	2
BECS7208 Data Base Management System Lab.	0-0-3	2
PCME7202 Mechanical Engg. Lab OR PCME7203 Machine Shop and Fabrication Practice	0-0-3	2
Practical/Sessional Credits		**6**
Total Credits		**27**

4th Semester

Theory	*Contact Hrs.* L-T-P	*Credit*
BSCM1210 Mathematics - IV	3- 1-0	4
PCME4204 Kinematics & Dynamics of Machines	3- 1- 0	4
PCME4205 Engg.Thermodynamics	3- 0- 0	3
PCME4206 Basic Manufacturing Processes	3- 0- 0	3
HSSM3205Organizational Behaviour OR HSSM3204 Engg. Economics & Costing	3- 0- 0	3
Free Elective-I (any one) BEEE2215 Energy Conversion Techniques/ PCCE4205 Surveying BECS2212 C++ & Object Oriented Programming/ BEEC2216 Analog and Digital Electronics	3-0-0	3
Theory Credits		**20**

Practicals/Sessionals	*Contact Hrs.*	*Credit*
PCME7204 Material Testing & Hydraulic Machines Lab	0- 0- 3	2
PCME7203 Machine Shop and Fabrication Practice OR PCME7202 Mechanical Engineering Lab	0- 0- 3	2
HSSM7203 Communication & Interpersonal Skills for Corporate Readiness	0- 0- 3	2
Practical/Sessional Credits		**6**
Total Credits		**26**

BSCM1205 **Mathematics - III**

Module-I **(18 hours)**

Partial differential equation of first order, Linear partial differential equation, Non-linear partial differential equation, Homogenous and non-homogeneous partial differential equation with constant co-efficient, Cauchy type, Monge's method, Second order partial differential equation The vibrating string, the wave equation and its solution, the heat equation and its solution, Two dimensional wave equation and its solution, Laplace equation in polar, cylindrical and spherical coordinates, potential.

Module-II **(12 hours)**

Complex Analysis:
Analytic function, Cauchy-Riemann equations, Laplace equation, Conformal mapping, Complex integration: Line integral in the complex plane, Cauchy's integral theorem, Cauchy's integral formula, Derivatives of analytic functions

Module –III (10 hours)

Power Series, Taylor's series, Laurent's series, Singularities and zeros, Residue integration method, evaluation of real integrals.

Text books:

1. E. Kreyszig," Advanced Engineering Mathematics:, Eighth Edition, Wiley India Reading Chapters: 11,12(except 12.10),13,14,15
2. B.V. Ramana, " Higher Engineering Mathematics", McGraw Hill Education, 2008 Reading chapter: 18

Reference books:

1. E.B. Saff, A.D.Snider, " Fundamental of Complex Analysis", Third Edition, Pearson Education, New Delhi
   P. V. O'Neil, "Advanced Engineering Mathematics", CENGAGE Learning, New Delhi

PCME4201 **Fluid Mechanics and Hydraulic Machines**

Module I **(13 Lectures)**

Introduction : Scope of fluid mechanics and its development as a science

Physical property of Fluid: Density, specific gravity, specific weight, specific volume, surface tension and capillarity, viscosity, compressibility and bulk modulus, Fluid classification.

Fluid statics: Pressure, Pascal's Law, Pressure variation for incompressible fluid, atmospheric pressure, absolute pressure, gauge pressure and vacuum pressure, manometer.

Hydrostatic process on submerged surface, force on a horizontal submerged plane surface, force on a vertical submerged plane surface.

Buoyancy and floatation, Archimedes' principle, stability of immersed and floating bodies, determination of metacentric height.

Fluid kinematics : Introduction, description of fluid flow, classification of fluid flow. Reynold's number, Acceleration of fluid particles, flow rate and continuity equation, differential equation of continuity,

Mathematical definitions of irrotational and rotational motion. Circulation, potential function and stream function. Flow net

Module II **(12 Lectures)**

Fluid dynamics : Introduction, Euler's equation along a streamline, energy equation, Bernoulli's equation and its application to siphon, venturimeter, orificemeter, pitot tube.

Flow in pipes and ducts: Loss due to friction, Minor energy losses in pipes Hydraulic Gradient Line (HGL), Total Energy Line (TEL), Power transmission in the fluid flow in pipes, fluid flow in pipes in series and parallel. Flow through nozzles.

Module III **(15 Lectures)**

Hydraulic turbine: Classification, Impulse and Reaction turbine; Tangential, Radial and axial turbine.

Impulse turbine, Pelton wheel, bucket dimensions, number of buckets in pelton wheel, efficiency and performance curves.

Reaction Turbines: Francis turbine and Kaplan turbine, velocity triangle and efficiencies, performance curve. Function of draft tube and casing cavitation

Centrifugal Pump: constructional features, vane shape, velocity triangles, Efficiencies, Multi stage centrifugal pumps, Pump Characteristic, NPSH and Cavitation.

Positive displacement pumps: Reciprocating Pump, Working principle, Discharge, work done and power requirement, Slip, Indicator diagram

Text Books

1. Fluid Mechanics and Hydraulic Machines, Modi & Seth
2. Introduction to Fluid Mechanics and Fluid Machines by S.K. Som and G. Biswas, TMH
3. Fluid Mechanics, A.K.Jain, Khanna Publishers

Reference Books:

1. Fluid Mechanics by A.K. Mohanty, PHI
2. Introduction to Fluid Mechanics by Fox, McDonald, Willey Publications
3. Fluid Mechanics by Kundu, Elsevier
4. An Introduction to Fluid Dynamics by G.K.Batchelor, Cambridge University Press
5. Engineering Fluid Mechanics by Garde et. al., Scitech
6. First course in Fluid Mechanics by Narasimhan, University press
7. Fluid Mechanics by J.F.Douglas, J.M.Gasiorek, J.A.Swaffield and L.B.Jack, Pearson Education

PCME4202 **Mechanics of Solids**

MODULE - I (14 Lectures)

1. Load, Stress, Principle of St.Venant, Principle of Superposition, Strain, Hooke's law, Modulus of Elasticity, Stress-Strain Diagrams, Working Stress, Factor of safety, Strain energy in tension and compression, Resilience, Impact loads,
   Analysis of Axially Loaded Members : Composite bars in tension and compression - temperature stresses in composite rods, Statically indeterminate problems.
   Shear stress, Complimentary shear stress, Shear strain, Modulus of rigidity, Poisson's ratio, Bulk Modulus, Relationship between elastic constants.
2. Members in Biaxial State of Stress :
   Stresses in thin cylinders, thin spherical shells under internal pressure - wire winding of thin cylinders. Analysis of Biaxial Stress. Plane stress, Principal stress, Principal plane, Mohr's Circle for Biaxial Stress.
3. Strain Deformation :
   Two dimensional state of strain, Mohr's circle for strain, Principal strains and principal axes of strain measurements, Calculation of principal stresses from principal strains.

MODULE - II (13 Lectures)

4. Shear Force and Bending Moment for Simple Beams :
   Shear force and bending moment. Types of load and Types of support. Support reactions, Relationship between bending moment and shear force, Point of inflection. Shear Force and Bending Moment diagrams.
5. Simple Bending of Beams :
   Theory of simple bending of initially straight beams, Bending stresses, Shear stresses in bending, Distribution of normal and shear stress, beams of two materials, Composite beams.
6. Deflection of Beams :
   Differential equation of the elastic line, Slope and deflection of beams by integration method and area - moment method.

MODULE - III (12 Lectures)

7. Theory of Columns:
   Eccentric loading of a short strut, Long columns, Euler's column formula, Lateral buckling, Critical Load, Slenderness ratio
8. Torsion in solid and hollow circular shafts, Twisting moment, Strain energy in shear and torsion, strength of solid and hollow circular shafts. Stresses due to combined bending and torsion, Strength of shafts in combined bending and twisting.
9. Close - Coiled helical springs.

TEXT BOOKS

1. Elements of Strength of Materials by S.P.Timoshenko and D.H.Young, Affiliated East-West Press
2. Strength of Materials by G. H. Ryder, Macmillan Press
3. Strength of Materials by James M. Gere and Barry J. Goodno, Cengage Learning

REFERENCE BOOKS

1. Mechanics of Materials by Beer and Johnston, Tata McGraw Hill
2. Mechanics of Materials by R.C.Hibbeler, Pearson Education
3. Mechanics of Materials by William F.Riley, Leroy D.Sturges and Don H.Morris, Wiley Student Edition
4. Mechanics of Materials by James M. Gere, Thomson Learning
5. Engineering Machanics of Solids by Egor P. Popov, Prentice Hall of India
6. Strength of Materials by S.S.Rattan, Tata Mc Graw Hill
7. Strength of Materials by R.Subramaniam, Oxford University Press
8. Strength of Materials by Sadhu Singh, Khanna Publishers

PCME4203 Introduction to Physical Metallurgy and Engineering Materials

MODULE-I **(16 Lectures)**

Classification of Engineering Materials, Engineering properties of materials. Characteristic property of metals, bonding in solids, primary bonds like ionic, covalent and metallic bond, crystal systems, common crystal structure of metals, representations of planes and directions in crystals, atomic packing in crystals, calculation of packing density, voids in common crystal structures and imperfections crystals.

Concept of plastic deformation of metals, critical resolve shear stress, dislocation theory, deformation by slip and twin, plastic deformation in polycrystalline metals, yield point phenomenon and related effects, concept of cold working preferred orientation. Annealing ; recovery; recrystalization and grain growth; hot working.

MODULE-II **(16 Lectures)**

Concept of alloy formation, types of alloys, solid solutions, factors governing solids solubility viz. size factor, valency factor, crystal structure factor and chemical affinity factor; order-disorder transformation.

Binary phase diagrams a) Isomorphism system, (b) Eutectic system, (c) Peritectic system, (d)Eutectoid system and (e) Peritectoid system. Allotropic transformation. Lever rule and its application, Interpretation of solidification behaviors and microstructure of different alloys belonging to those systems, Effect of non-equilibrium cooling, coring and homogenization.
Iron-cementite and iron-graphite phase diagrams, microstructure and properties of different alloys (alloy steels; stainless steel, tool steel, HSS, high strength low alloy steel) types of cast iron, their microstructures and typical uses. Specification of steel.

T.T.T. diagram: concept of heat treatment of steels i.e. annealing, normalizing, hardening and tempering; microstructural effects brought about by these processes and their influences on mechanical properties; factor affecting hardenability.

MODULE-III **(12 Lectures)**

Optical properties of Materials: Scattering, Refraction, Theory of Refraction and absorption, Atomic Theory of optical properties. Lasers, Optical fibres- Principle, structure, application of optical fibres.
Plastic-: Thermosetting and thermoplastics.
Ceramics: Types, structure, Mechanical properties, application
Composite Materials: Agglomerated Materials: Cermets .Reinforced Materials: Reinforced Concrete. Glass fiber reinforced plastics, Carbon fibre reinforced plastics, fibre reinforced plastics, Laminated plastic sheets. Tefnol, Properties of composites, Metal matrix composites, manufacturing procedure for fiber reinforced composite.
Introduction to Nano-materials

Text Books:

1. Engineering Physical Metallurgy and Heat Treatment by Y.Lakhtin, Mir Publisher, Moscow.
2. Introduction to Physical Metallurgy by Avner, Tata McGraw Hill
3. Materials Science and Engineering by W.D.Callister, Wiley and Sons Inc.

Reference Books

1. Elements of Material Science and Engineering, L.H.Van Vlack, Addison Wesley
2. Physical Metallurgy: Principles and Practice by Ragahvan, PHI
3. The Science and Engineering of Materials by Donald R. Askeland and Pradeep P Phule, Thomson Learning (India Edition)
4. Materials Science and Engineering by V.Raghavan, Prentice Hall of India Pvt.Ltd.
5. Essentials of Material Science and Engineering by Donald R. Askeland and Pradeep P Phule, Thomson Learning
6. Processes and Material of manufacture by Lindberg, PHI.
7. Elements of Materials Science & Engineering by Van Vlack, Pearson
8. Mechanical Metallurgy by Dieter, Tata MacGraw Hill
9. Materials Science and Metallurgy By Daniel Yesudian, Scitech
10. Material Science and Metallurgy by C.K.Dutta, Dhanpat Rai
11. Materials Science and Metallurgy by R.B.Choudhary, Khanna Publishers
12. Principles of Engineering Metallurgy by L.Krishna Reddy, New Age International
13. Material Science and Processes by S.K.Hazra Chowdhury, Indian Book distributing Co.
14. Engineering Materials, Properties and Selection by Kenneth G. Budinski and Michael K. Budinski, Prentice Hall of India
15. Materials Science by M.S. Vijaya , G.Rangarajan, TMH
16. Materials Science by V. Rajendra, A. Marikani, , TMH

HSSM3204 **Engineering Economics & Costing**

Module-I: **(12 hours)**

Engineering Economics – Nature and scope, General concepts on micro & macro economics. The Theory of demand, Demand function, Law of demand and its exceptions, Elasticity of demand, Law of supply and elasticity of supply. Determination of equilibrium price under perfect competition (Simple numerical problems to be solved). Theory of production, Law of variable proportion, Law of returns to scale.

Module-II: **(12 hours)**

Time value of money – Simple and compound interest, Cash flow diagram, Principle of economic equivalence. Evaluation of engineering projects – Present worth method, Future worth method, Annual worth method, internal rate of return method, Cost-benefit analysis in public

projects. Depreciation policy, Depreciation of capital assets, Causes of depreciation, Straight line method and declining balance method.

Module-III: (12 hours)

Cost concepts, Elements of costs, Preparation of cost sheet, Segregation of costs into fixed and variable costs. Break-even analysis-Linear approach. (Simple numerical problems to be solved)
Banking: Meaning and functions of commercial banks; functions of Reserve Bank of India. Overview of Indian Financial system.

Text Books:

1. Riggs, Bedworth and Randhwa, "Engineering Economics", McGraw Hill Education India.
2. M.D. Mithani, Principles of Economics.

Reference Books :

1. Sasmita Mishra, "Engineering Economics & Costing ", PHI
2. Sullivan and Wicks, " Engineering Economy", Pearson
3. R.Paneer Seelvan, " Engineering Economics", PHI
4. Gupta, " Managerial Economics", TMH
5. Lal and Srivastav, " Cost Accounting", TMH

HSSM 3205 **Organizational Behaviour**

Module I :

The study of Organizational Behaviour : Defination and Meaning, Why Study OB
Learning – Nature of Learning, How Learning occurs, Learning and OB.
Foundations of Individual Behaviour : Personality – Meaning and Defination, Determinants of Personality, Personality Traits, Personality and OB.
Perception – Meaning and Definition, Perceptual Process, Importance of Perception in OB. Motivation – Nature and Importance, Herzberg's Two Factor Theory, Maslow's Need Hierarchy Theory, Alderfer's ERG Theory, Evaluations.

Module II :

Organizational Behaviour Process : Communication – Importance, Types, Gateways and Barriers to Communication, Communication as a tool for improving Interpersonal Effectiveness, Groups in Organizations – Nature, Types, Why do people join groups, Group Cohesiveness and Group Decision-making Managerial Implications, Effective Team Building. Leadership-Leadership & Management, Theories of Leadership-Trait theory, Leader Behaviour theory, Contingency Theory, Leadership and Followership, How to be an effective Leader, Confict-Nature of Conflict and Conflict Resolution. An Introduction to Transactional Analysis (TA).

Module-III :

Organization : Organizational Culture – Meaning and Definition, Culture and Organizational Effectiveness. Introduction to Human Resource Management-Selection, Orientation, Training and Development, Performance Appraisal, Incentives Organizational Change – Importance of Change, Planned Change and OB techniques. International Organisational Behaviour – Trends in International Business, Cultural Differences and Similarities, Individual and Interpersonal Behaviour in Global Perspective.

Text Books :

1. Keith Davis, Organisational Behaviour, McGraw-Hill.
2. K.Aswathappa, Organisational Behaviour, Himalaya Publishing House.

Reference Books :

1. Stephen P. Robbins, Organisational Behaviour, Prentice Hall of India
2. Pradip N. Khandelwal, Organizational Behaviour, McGraw-Hill, New Delhi.
3. Uma Sekaran, "Organizational Behaviour", TATA McGraw-Hill, New Delhi.
4. Steven L McShane, Mary Ann Von Glinow, Radha R Sharma" Organizational Behaviour" , TATA McGraw- Hill.
5. D.K. Bhattachayya, "Organizational Behaviour", Oxford University Press
6. K.B.L.Srivastava & A.K.Samantaray, "Organizational Behaviour" India Tech

BECS2208 Database Management System

Module I : (10 hours)

Database System Architecture - Data Abstraction, Data Independence, Data Definitions and Data Manipulation Languages. Data models - Entity Relationship(ER), Mapping ER Model to Relational Model, Network .Relational and Object Oriented Data Models, Integrity Constraints and Data Manipulation Operations.

Module II : (12 hours)

Relation Query Languages, Relational Algebra and Relational Calculus, SQL.

Relational Database Design: Domain and Data dependency, Armstrong's Axioms, Normal Forms, Dependency Preservation, Lossless design.

Query Processing Strategy.

Module III: (10 hours)

Transaction processing: Recovery and Concurrency Control. Locking and Timestamp based Schedulers.
Database Recovery System: Types of Data Base failure & Types of Database Recovery, Recovery techniques

Text Books:

1. Database System Concepts by Sudarshan, Korth (McGraw-Hill Education)
2. Fundamentals of Database System By Elmasari & Navathe- Pearson Education

References Books:

(1) An introduction to Database System – Bipin Desai, Galgotia Publications
(2) Database System: concept, Design & Application by S.K.Singh (Pearson Education)
(3) Database management system by leon &leon (Vikas publishing House).
(4) Fundamentals of Database Management System – Gillenson, Wiley India
(5) Database Modeling and Design: Logical Design by Toby J. Teorey, Sam S. Lightstone, and Tom Nadeau, "", 4th Edition, 2005, Elsevier India Publications, New Delhi

PCME7201 **Machine Drawing**

Orthographic and Sectional drawing of Machine components: (Any seven)
Screw threads, Screwed fastenings, Turn Buckle, Keys, Cotter joints and Knuckle joints; Pulley; Flanged coupling, Pedestal Bearing or Plummer Block.
Fundamentals of AutoCAD (Two classes)

1. Dimension & annotations
2. Use of Layers
3. Working with constraint in dimension
4. Creating assembly
5. Axi-symmetrical parts
6. Creating surface features
7. Working with bill of material

Drawing of the following using AUTOCAD: (Any two)

1. Projection of solids
2. Nut & bolt and Fasteners
3. Cotter joint
4. Expansion joint
5. Shaft coupling

Text Books:

1. Machine Drawing by N.D.Bhatt, V.M.Panchal, Charotar Publishing House.
2. Machine Drawing by N.D.Junarkar, Pearson Education
3. Machine Drawing with AutoCAD by Goutam Pohit and Goutam Ghosh, Pearson Education
4. Machine Drawing includes AutoCAD by Ajeet Singh, Tata MacGraw Hill

Reference Books:

1. Machine Drawing by K.L.Narayana, P.Kannaiah, K.Venkata Reddy, New Age International
2. Engineering Drawing and Graphics using AUTOCAD by T.Jayapoovan, Vikas Publishing
3. Engineering Drawing by N.D.Bhatt, Charotar
4. Engineering Drawing and Graphics + AutoCAD by K.Venugopal, New Age International

BECS7208 **Database Managements System Lab**

1. Use of SQL syntax: insertion, deletion, join, updation using SQL. (1 class)
2. Programs on join statements and SQL queries including where clause. (1 class)
3. Programs on procedures and functions. (1 class)
4. Programs on database triggers. (1 class)
5. Programs on packages. (1 class)
6. Programs on data recovery using check point technique. (1 class)
7. Concurrency control problem using lock operations. (1 class)
8. Programs on ODBC using either VB or VC++. (1 class)
9. Programs on JDBC. (1 class)
10. Programs on embedded SQL using C / C++ as host language. (1 class)

PCME7202 **Mechanical Engineering Lab**

Group A

1. Determination of equilibrium of coplanar forces.
2. Determination of Moment of Inertia of Flywheel
3. Determination of tensile strength of materials by Universal Testing Machine.

Group B

4. Determination of Metacentric Height and application to stability of floating bodies.
5. Verification of Bernoulli's Theorem and its application to Venturimeter.
6. Determination of Cv and Cd of Orifices.

Group C

7. Calibration of Bourdon Tube Pressure gauge and measurement of pressure using manometers.
8. Study of Cut-Sections of 2 stroke and 4 stroke Diesel Engine.
9. Study of Cut-Sections of 2 stroke and 4 stroke Petrol Engine.

PCME7203 **Machine Shop and Fabrication Practice**

1. A job on lathe with taper turning, thread cutting, knurling and groove cutting
2. Gear cutting (with index head) on milling m/c
3. Working with shaper, planer and slotting m/c
4. Working with surface/ cylindrical grinding
5. TIG/ MIG welding, gas cutting

BSCM1210 **Mathematics – IV**

Module-I **(20 hours)**

Numerical methods:
Approximation and round of errors, Truncation error and Taylor's series
Roots of equation: The bisection method, the false-position method, fixed point iteration, the Newton-Raphson method, Muller's method
Linear algebraic equation: LU decomposition, the matrix inverse, Gauss-Seidel method
Interpolation: Newton divided difference interpolation, Lagrange Interpolation, Newton's forward and backward interpolation.
Numerical integration: The trapezoidal rule, The Simpson's rules, Gauss quadrature
Ordinary differential equation: Euler's method, Improvement of Euler's method, Runge-Kutta methods

Module-II **(10 Hours)**

Probability:
Probability, Random variables, Probability distributions, Mean and variance of distribution, Binomial, Poisson and Hypergeometric distributions, Normal distribution, Distribution of several random variables.

Module-III **(10 Hours)**

Mathematical Statistics:
Random sampling, Estimation of Parameters, Confidence Intervals, Testing of hypothesis, Acceptance sampling, Chi square test for goodness of fit , Regression Analysis, Fitting Straight Lines, Correlation analysis.

Text books:

1. S. C. Chapra and R. P. Canale, " *Numerical methods for Engineers*", Fifth Edition, McGraw Hill Education
   Reading Chapters : 2, 3(3.1, 3.2), 4(4.2, 4.3), 5(5.1, 5.2, 5.3), 6(6.4), 9(9.1, 9.2), 10(10.2), 13(13.1,13.2,13.5), 16(16.1, 16.2), 17(17.3), 20(20.1, 20.2, 20.3)

2. E. Kreyszig," Advanced Engineering Mathematics:, Eighth Edition, Wiley India
   Reading Chapters: 22, 23(except 23.5 and 23.8)

Reference books:

1. Jay L. Devore, "Probability and Statistics for Engineering and Sciences", Seventh Edition, Thomson/CENGAGE Learning India Pvt. Ltd

P. V.O'Neil, "Advanced Engineering Mathematics", CENGAGE Learning, New Delhi

PCME4204 **Kinematics and Dynamics of Machines**

Module - I **(13Lectures)**

1. Mechanisms : Basic Kinematic concepts and definitions, Mechanism, Link, Kinematic Pair, Classification of kinematic pairs, Degrees of freedom, Kinematic chain, Binary Ternary and Quaternary joints and links, Degrees of freedom for plane mechanism, Gruebler's criterion, Inversion of mechanism, Four bar chains and their inversions, Single slider crank chain, Double slider crank chain and their inversion.
2. Kinematic Analysis : Determination of velocity using graphical and analytical techniques, Instantaneous centre method, Relative velocity method, Kennedy theorem, Velocity in four bar mechanism, Slider crank mechanism, Rubbing velocity at a Pin-joint.
   Acceleration Diagram for a slider - crank mechanism, Corioli's component of acceleration and its application.

Module - III **(14 Lectures)**

3. Inertia forces in reciprocating Parts : Velocity and acceleration of piston by analytical method, Angular velocity and angular acceleration of connecting rod by analytical method and by graphical method, Piston effort, force acting along the connecting rod, Crank effort, Turning moment on crank - shaft.
4. Dynamically equivalent system, compound Pendulum, correction couple.
   Turning moment diagrams for different types of engines, Fluctuation of energy and fluctuation of speed.
4. Friction of a screw and nut, Square threaded screw, V-threaded screw, Pivot and collar friction, friction circle, Friction axis, Friction clutches, Transmission of power by single plate, mutiplate and cone clutches.

Module - III **(13Lectures)**

6. Brakes & Dynamometers : Classification of brakes, Analysis of simple block, Band and internal expanding shoe brake, Braking of a vehicle.
   Absorption and transmission dynamometers, Prony brake, Rope brake, Band brake dynamometer, Belt transmission dynamometer, Torsion dynamometer.
7. Gear Trains : Simple Train, Compound train, Reverted train, Epicyclic train and their applications.
8. Belt, rope and chain drives, Initial tension, Effect of centrifugal tension on power transmission, Maximum power transmission capacity, Belt creep and slip.

Text Books

1. Theory of Machines by Thomas Bevan, CBS Publications
2. Theory of Machines by S.S.Rattan, Tata MacGraw Hill

Reference

1. Kinematics and Dynamics of Machinery by Charles E. Wilson and J.Peter Saddler, Pearson Education
2. Theory of Machines and Mechanisms (India Edition) by John J. Uicker Jr., Gordon R. Pennock and Joseph E. Shigley, Oxford University Press
3. Theory of Machines and Mechanisms by P.L.Ballaney, Khanna Publishers
4. Mechanism and Machine Theory by J.S.Rao and R.V.Dukipatti, New Age International
5. Theory of Mechanisms and Machines by C.S.Sharma and K.Purohit, Prentice Hall of India
6. Theory of Machines by R.S.Khurmi and J.K.Gupta, S.Chand Publication
7. Theory of Machines by Shah Jadwani, Dhanpat Rai
8. A Textbook of Theory of Machines by R. K. Bansal, Laxmi Publication
9. Theory of Machines by Abdulla Shariff, Dhanpat Rai Publishers
10. Theory of Machines by Sadhu Singh, Pearson Education

PCME4205 **Engineering Thermodynamics**

Module-I (13 Lectures)

1. Review of First and Second laws:

   First law analysis of unsteady flow control volumes, Entropy generation, Reversible work, Availability, and Irreversibility.

2. General Thermodynamic property relations:

   The Maxwell relations, The Clapeyron equation, The TdS relations, Isothermal compressibility and volume expansivity, The Joule-Thomson coefficient.

3. Reciprocating Air Compressors:

   Introduction (Uses of compressed air), The reciprocating cycle neglecting and considering clearance volume, Volumetric efficiency and its effect on compressor performance, Limitations of single stage compression, Multistage compression and intercooling, Optimum intercooler pressure, Performance and design calculations of reciprocating compressors, Air motors.

Module- II (10 Lectures)

4. Vapor Power Cycles:

   The Carnot vapor cycle and its limitations, The Rankine cycle, Means of increasing the Rankine cycle efficiency, The reheat cycle, The regenerative feed heating cycle, The binary vapor cycle, The gas-vapor coupled cycles, Cogeneration (Back pressure and Pass-out turbines).

Module- III (12 Lectures)

4. Gas Power Cycles:

   Air standard cycles- Otto, Diesel, Dual Combustion and Brayton cycles, The Brayton cycle with non-isentropic flow in compressors and turbines, The Brayton cycle with regeneration, reheating and intercooling, Ideal jet propulsion cycle.

5. Refrigeration cycles:

   Reversed Carnot cycle, Reversed Brayton cycle (Gas refrigeration system), The vapor compression cycle, The vapor absorption cycle.

Text Books

1. Engineering Thermodynamics by P. K. Nag, Publisher:TMH
2. Fundamentals of Thermodynamics by Sonntag, Borgnakke, Van Wylen, John Wiley & Sons
3. Fundamentals of Engineering Thermodynamics by E. Rathakrishnan, PHI

Reference

1. Engineering Thermodynamics by M.Achyuthan, PHI
2. Engineering Thermodynamics by Y.V.C. Rao, University Press
3. Steam Tables in SI Units by Ramalingam, Scitech
4. Steam Tables by C.P.Kothandaraman, New Age International
5. Thermodynamics and Thermal Engineering by Kothandaraman & Domkundwar, Dhanpat Rai
6. Applied Thermodynamics by P.L.Ballaney, Khanna Publishers
7. Fluid Mechanics by J.F.Douglas, J.M.Gasiorek, J.A.Swaffield and L.B.Jack, Pearson Education.

PCME4206 **Basic Manufacturing Process**

Module - I **(12 Lectures)**

1. Foundry :
   (a) Types of patterns, pattern materials and pattern allowances.
   (b) Molding Materials - sand molding, metal molding, investment molding, shell molding.
   (c) Composition of molding sand, Silica sand, Zircon sand, binders, additives, Binders - clay, binders for CO_2 sand, binder for shell molding, binders for core sand.
   (d) Properties of molding sand and sand testing.
   (e) Melting furnaces - cupola, resistance furnace, induction and arc furnace.
   (f) Solidification of castings, design of risers and runners, feeding distance, centre line freezing resistance chills and chaplets.
   (g) Degasification and inoculation of metals.
   (h) Casting methods like continuous casting, centrifugal casting, disc casting.
   (i) Casting defects.

Module – II **(12 Lectures)**

2. Welding and cutting: Introduction to gas welding, cutting, Arc welding and equipment's. TIG (GTAW) and MIG (GMAW) welding, resistance welding and Thermit welding. Weldablity

   Modern Welding methods like plasma Arc, Laser Beam, Electron Beam, Ultrasonic, Explosive and friction Welding, edge preparation in butt welding.

   Brazing and soldering, welding defects.

   Destructive and non-destructive testing of castings and welding.
3. Brief introduction to powder metallurgy processes.

Module – III **(14 Lectures)**

4. Plastic deformation of metals: Variables in metal forming and their optimization. Dependence of stress strain diagram on Strain rate and temperature. Hot and cold working of metals, classification of metal forming processes.
5. Rolling: Pressure and Forces in rolling, types of rolling mills, Rolling defects.
6. Forging: Smith Forging, Drop and Press forging, M/c forging, Forging defects.
7. Extrusions: Direct, Indirect, Impact and Hydrostatic extrusion and their applications, Extrusion of tubes.
8. Wire drawing methods and variables in wire-drawing, Optimum dies shape for extrusion and drawing.
9. Brief introduction to sheet metal working: Bending, Forming and Deep drawing, shearing.
10. Brief introduction to explosive forming, coating and deposition methods.

Text Books

1. Manufacturing technology - by P.N.Rao, Tata McGraw Hill publication.
2. Welding Technology by R.A. Little, TMH
3. Manufacturing Science by A.Ghosh and A K Malick, EWP

Reference Books

1. Fundamentals of metal casting technology by P.C. Mukherjee, Oxford PIBI.
2. Mechanical Metallurgy by Dieter, Mc-Graw Hill
3. Processes and Materials of Manufacture by R.A Lindberg, Prentice hall (India)
4. A Text Book of Production Engineering by P.C.Sharma, S.Chand

BEEE2215 **Energy Conversion Techniques**

MODULE- I (10 Hrs)

1. DC GENERATORS: Constructional features and operating principles, EMF equation, No Load Characteristics for Separately Excited DC Generator and DC Shunt Generator, Conditions for Self Excitation, Critical Resistance and Critical Speed, Losses and Efficiency.
2. DC MOTORS: Speed~Armature Current, Torque~Armature Current and Speed~Torque Characteristic for (i) Separately Excited DC Motor, (ii) DC Shunt Motor, (iii) DC Series Motor, Starting, Speed control and application of DC motor.

MODULE- II (10 Hrs)

3. SINGLE PHASE TRANSFORMERS: Constructional Features, EMF Equation, Turns Ratio, Open Circuit Test and Short Circuit Test, Losses and Efficiency, Introduction to Three Phase Transformers: Three Single Phase Transformers Connected as a Bank of Three Phase Transformer.
4. INDUCTION MOTORS: (a) Three Phase Induction Motors: Constructional Features of Squirrel Cage Rotor type and Slip Ring/Wound Rotor type of Induction Motors, Principle of Operation, Concept of Slip, Slip~Torque Characteristics, Starting of Squirrel Cage Rotor type and Slip Ring/Wound Rotor type of Induction Motors, Speed Control of Induction Motors.

   (b) Introduction to Single Phase Induction Motors: Construction, Principle of Operation and Application.

MODULE- III (10 Hrs)

5. THREE PHASE SYNCHRONOUS GENERATORS: Constructional Features, Principle of operation as Alternator, Synchronous reactance, Equivalent circuit of alternator, Power-Angle curve, Synchronization of alternators.
6. THREE PHASE SYNCHRONOUS MOTORS: Constructional Features, Principle of Operation, Torque Expression and Phasor Diagram for Synchronous Motor, Electrical Power and Mechanical Power, Starting and application of Synchronous Motor.

Text Book :

1. Electric Machines – D P Kothari & I J Nagrath – Tata McGraw Hill.

Reference Book(s):

2. The Performance and Design of DC Machines – A E Clayton.
3. Theory and Performance of AC Machines – M G Say
4. Electrical Machinery – P S Bimbhra – Khanna Publishers.
5. Electrical Machines – P K Mukherjee and S Chakravorti – Dhanpat Rai Publications.
6. Electric Machinery – Fitzgerald, Charles Kingsley Jr., S. D. Umans – Tata Mc Graw Hill.
7. Electric Machinery And Transformers – Guru & Hiziroglu – Oxford University Press.
8. Electric Machines – Charles Hubert – Pearson Education.

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PCCE4205 Surveying

Module I

Linear measurement and chain survey: Use of various types of chains and tapes, measurement of correct length of lines, direct and indirect ranging, chaining along sloping ground. Obstacle in chaining, errors and their elimination.

Compass surveying: Use of prismatic compass, temporary adjustment, bearing of a line, local attractions, correction of bearing

Plane table surveying: Methods of plane tabling, radiations, intersection, traversing and resection, two point and three point problem. Adjustment and common error in plane table survey.

Module II

Levelling: Use of dumpy level and levelling staff. Temporary and Permanent adjustment of dumpy level, Reduction of levels by height of instrument and rise and fall method. Curvature and refraction error, sensitiveness of level tube, reciprocal levelling, levelling difficulties and common errors

Module III

Contouring: Contour interval and horizontal equivalent, characteristics of contours, methods of contouring- different and indirect method, contour gradient

Theodolite Survey: Use of theodolite, temporary adjustment, measuring horizontal and vertical angles, theodolite traversing

TEXT BOOKS:

1. Surveying and Levelling Vol-1, T. P. Kanetkar and S. V. Kulkarni
2. Surveying- Vol-1, B.C. Punmia
3. Surveying Vol01 by R Agor

BECS2212 C++ and Object Oriented Programming

Module I **(08 hrs)**

Introduction to object oriented programming, user defined types, structures, unions, polymorphism, encapsulation. Getting started with C++ syntax, data-type, variables, strings, functions, default values in functions, recursion, namespaces, operators, flow control, arrays and pointers.

Module II **(16 hrs)**

Abstraction mechanism: Classes, private, public, constructors, destructors, member data, member functions, inline function, friend functions, static members, and references.
Inheritance: Class hierarchy, derived classes, single inheritance, multiple, multilevel, hybrid inheritance, role of virtual base class, constructor and destructor execution, base initialization using derived class constructors.
Polymorphism: Binding, Static binding, Dynamic binding, Static polymorphism: Function Overloading, Ambiguity in function overloading, Dynamic polymorphism: Base class pointer, object slicing, late binding, method overriding with virtual functions, pure virtual functions, abstract classes.
Operator Overloading: This pointer, applications of this pointer, Operator function, member and non member operator function, operator overloading, I/O operators.
Exception handling: Try, throw, and catch, exceptions and derived classes, function exception declaration.

Module III **(08 hrs)**

Dynamic memory management, new and delete operators, object copying, copy constructor, assignment operator, virtual destructor.
Template: template classes, template functions.
Namespaces: user defined namespaces, namespaces provided by library.

Text Books:

1. Object Oriented Programming with C++ - E. Balagurusamy, McGraw-Hill Education (India)
2. ANSI and Turbo C++ - Ashoke N. Kamthane, Pearson Education

Reference Books:

1. Big C++ - Wiley India
2. C++: The Complete Reference- Schildt, McGraw-Hill Education (India)
3. “C++ and Object Oriented Programming” – Jana, PHI Learning.
4. “Object Oriented Programming with C++ “- Rajiv Sahay, Oxford
5. Mastering C++ - Venugopal, McGraw-Hill Education (India)

“Object Oriented Programming with C++”, David Parsons, Cengage Learning.

BEEC2216 **Analog and Digital Electronics**

MODULE – I **(9 Hours)**

1. **Diode Circuits:** Zener Diode Voltage Regulator, Diode Circuits with Time-Varying Sources, Switching Characteristics of a Diode, Special Purpose Diodes , Rectifiers and Filters. (4 Hours)

2. **Small Signal Amplifier:** Transistor Hybrid Model, Transistor Biasing, Bias Design, AC Gain, Input and Output Impedances, Some Special Circuits, Darlington Pairs and Feedback Pairs, Frequency Response of Single Stage RC Coupled Amplifiers and Multistage Transistor Amplifiers. (5 Hours)

MODULE – II (12 Hours)

3. **Large Signal Amplifiers:** Classification, Class-A and Class-B Power Amplifiers Complimentary and Symmetry Amplifiers, Class-C Amplifiers. . (4 Hours)
4. **Feed Back Amplifiers and Oscillators:** Feedback Concepts, Types of Feedback Circuits, Effects of Negative Feedback Circuits, Unijunction Oscillator and PLL. (4 Hours)
5. **Operational Amplifier:** Basic Operational Amplifier, Differential Amplifier, Basic Operational Amplifier Circuits, Application of OPAMPs, Linear Application of OPAMPs, OPAMP Filters. (4 Hours)

MODULE – III (13 Hours)

6. **Conditional Circuits:** Introduction to Digital Electronics Circuits, K-maps and their Simplification, Adder, Subtractors, Digital Comparator Circuits, Parity Checkers/Generators, Multiplexers and Decoders, Demultiplexers/Decoders, Programmable Logic Arrays. (5 Hours)
7. **Sequential Circuits and Systems:** Introduction, Memory Cells and Flip-Flops, Resistors, Counters, Asynchronous Counters, State Diagrams, Memories, ROM and RAM, Digital to Analog and Analog to Digital Converters (DAC and ADC). (5 Hours)
8. **Multivibrators and Switching Regulators:** Multivibrators, Analog Multivibrators, 555 Timer, Power Supply and Regulators (3 Hours)

Text Books:

1. Electronics: Analog and Digital, I.J. Nagrath (Selected portions of Chapter 1, 3, 4, 5, 6, 7, 9, 10, 11), PHI Learning Pvt. Ltd., New Delhi.

Reference Books:

1. Millman's Electronic Devices and Circuits, 2nd Edition, J. Millman, C. Halkias, and S. Jit, Tata McGraw Hill Education Pvt. Ltd., New Delhi.
2. Electronic Devices and Circuit Theory, 9th/10th Edition, R.L. Boylestad and L. Nashelsky, Pearson Education, New Delhi.
3. Digital Fundamentals, 5th Edition, T.L. Floyd and R.P. Jain, Pearson Education, New Delhi.
4. Fundamentals of Digital Circuits, 2nd Edition, A. Anand Kumar, PHI Learning Pvt. Ltd., New Delhi.

PCME7204 **Material Testing and Hydraulic Machines Lab**

Material Testing :

1. Impact strength
2. Hardness strength
3. Rigidity modulus
4. Compression / Bending strength
5. Fatigue strength

Hydraulic Machines :

1. Experiments on impact of Jets
2. Experiments on performance of reciprocating pump
3. Experiments on performance of centrifugal pump
4. Experiments on performance of Pelton Turbine
5. Experiments on performance of Francis Turbine
6. Experiments on performance of Kaplan Turbine

HSSM7203 Communication & Interpersonal skills for Corporate Readiness Lab.

Lab **30 hours**

This course will focus on communication in professional (work-related) situations of the kind that BPUT graduates may expect to encounter on entering the professional domain.

Some typical forms of work-related communication, oral or written, are listed below. Practice activities for all four skills can be designed around these or similar situations.

1. Gaining entry into an organization

i. Preparing job-applications and CVs

ii. Facing an interview

iii. Participating in group discussion (as part of the recruitment process)

2 In-house communication

a. Superior/ Senior ➔ subordinate / junior (individual ➔ individual / group)
   i. Welcoming new entrants to the organization, introducing the workplace culture etc.
   ii. Briefing subordinates / juniors : explaining duties and responsibilities etc.
   ii. Motivating subordinates / juniors ('pep talk')
   iii. Instructing/ directing subordinates/ juniors
   iv. Expressing / recording appreciation, praising / rewarding a subordinate or junior
   v Reprimanding / correcting / disciplining a subordinate/junior (for a lapse) ; asking for an explanation etc.

b. Subordinate / Junior ➔ Superior / Senior
   i. Responding to the above
   ii. Reporting problems / difficulties / deficiencies
   iii. Offering suggestions

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BIJU PATNAIK UNIVERSITY OF TECHNOLOGY, ORISSA
MECHANICAL ENGINEERING

5th SEMESTER				6th SEMESTER			
THEORY		*Contact Hours*		*THEORY*		*Contact Hours*	
Code	*Subject*	*L-T-P*	*Credits*	*Code*	*Subject*	*L-T-P*	*Credits*
PCME4301	Machine Dynamics	3-0-0	3	HSSM3302	Optimization in Engineering	3-0-0	3
PCME4303	Design of Machine Elements	3-0-0	3	PCME4307	Advanced Mechanics of Solids	3-0-0	3
PCME4304	Machining Science & Technology	3-0-0	3	PCME4306	Design of Machine Components	3-0-0	3
PCME4302	I.C. Engines & Gas Turbines	3-0-0	3	PCME4305	Heat Transfer	3-0-0	3
	Professional Elective – I (Any one)	3-0-0	3		Professional Elective – I (Any one)	3-0-0	3
PEME5301	Automobile Engineering			PEME5305	Robotics & Robot Applications		
PEME5302	CAD & CAM			PEME5306	Modern Manufacturing Processes		
PEME5304	Tribology			PEME5307	Computer Integrated Manufacturing & FMS		
PEME5303	Rapid Prototyping			PEME5308	Non Conventional Energy Sources		
	Free Elective – I (*Any One*)	3-0-0	3		Free Elective – II (*Any One*)	3-0-0	3
FESM6302	Advance Numerical Methods			FEME6301	Finite Element Method		
PCEC4301	Microprocessors			PCEC4304	Digital Signal Processing		
FEME6302	Project Management			PCIT4301	Internet and web technology		
PCBM4301	Elements of Biomedical Instrumentation/			PECS5303	Pattern Recognition		
PCIT4303	Java Programming.			PEIT5301	Ecommerce		
		Credits (Theory)	18			Credits (Theory)	18
	PRACTICALS/SESSIONALS				*PRACTICALS/SESSIONALS*		
PCME7302	Production Lab & IC Engines Lab.	0-0-3	2	PCME7305	Heat Transfer & Heat Power Lab .	0-0-3	2
PCME7301	Machine Dynamics & Heat Power Lab	0-0-3	2	PCME7307	Numerical Computation & Solids Modeling Lab	0-0-3	2
PCME7303	Machine Design Project - I	0-0-3	2	PCME7306	Machine Design Project - II	0-0-3	2
	Credits (Practicals / Sessionals)		**6**		**Credits (Practicals/Sessionals)**		**6**
	TOTAL SEMESTER CREDITS		**24**		**TOTAL SEMESTER CREDITS**		**24**
	TOTAL CUMULATIVE CREDITS		**133**		**TOTAL CUMULATIVE CREDITS**		**157**

PCME4301 **MACHINE DYNAMICS** (3-0-0)

Module – I **(12 hours)**

1. Mechanisms with lower pairs : Motor Vehicle Steering Gears - Davis Steering Gear & Ackermann Steering Gear, Hooke's Joint.
2. Gyroscope : Concept on Gyroscopic Couple for Plane Disc & Two-bladed airscrew, Effect of Gyroscopic Couple on Ships & Aeroplanes, Stability of Two Wheelers and Four Wheelers. Analysis on bearing reactions due to Forced Precession of Rotating Disc mounted on Shafts, Introduction on Gyroscopic Stabilisation.
3. Toothed gears : **:** Gear terminology, law of gearing , Theory of shape and action of tooth properties and methods of generation of standard tooth profiles, Standard proportions, Path of contact, Arc of contact, Contact ratio, Interference and Under – Cutting, Methods for eliminating Interference, Minimum number of teeth to avoid interference.

Module II **(12 hours)**

4. Cams : Types of cams, Types of followers, Types of follower motions - Simple Harmonic, Uniform Velocity and Constant Acceleration & Retardation Types, Analysis for Displacement, velocity and Acceleration of Follower, Generation of Cam Profiles by Graphical Method, Introduction on Cams with specified contours.
5. Governors : Centrifugal Governors - Watt, Porter, Proell and Spring Loaded Governor of Hartnell type, Controlling Force & Controlling Force Curve, Sensitiveness, Stability, Isochronism, Hunting, Governor Effort and Power, Effect of Friction & Coefficient of insensitiveness.
6. Dynamics of Machines : Dynamic Force Analysis of Four-Bar Mechanism and Slider Crank Mechanism. using D'Alemberts Principle, Flywheel and Determination of its size from Turning Moment Diagram & Maximum Fluctuation of Energy.

Module III **(12 hours)**

7. Balancing : Static and Dynamic Balancing, Balancing of Single Rotating Mass by Balancing Masses in Same plane and in Different planes. Balancing of Several Rotating Masses rotating in Same plane and in Different planes. Effect of Inertia Force due to Reciprocating Mass on Engine Frame, Partial balance of single cylinder engines. Primary and Secondary Balance of Multi-cylinder In-line Engines. Direct and Reverse Crank method of balancing for radial engines.
8. Vibrations: Introduction to Mechanical Vibration – Longitudinal, Torsional & Transverse Systems, Concept on Degrees of Freedom. Free and Forced Vibration of Un-damped and Damped Single Degree Freedom Systems, Vibration isolation and transmissibility, Whirling of shafts and Evaluation of Critical Speeds of shafts..

Text Books

1. Theory of Machines by Thomas Bevan, CBS Publications
2. Theory of Machines by S.S.Rattan, Tata MacGraw Hill
3. Theory of Mechanisms and Machines by A.. Ghosh and A.. K.. Mallik, EWP

Reference

1. Kinematics & Dynamics of Machinery-Charles E. Wilson & J.Peter Saddler,Pearson Ed.
2. Theory of Machines and Mechanisms (India Edition) by John J. Uicker Jr., Gordon R. Pennock and Joseph E. Shigley, Oxford University Press
3. Kinematics and Dynamics of Machinery by R.L.Norton, Tata MacGraw Hill
4. Theory of Machines and Mechanisms by P.L.Ballaney, Khanna Publishers
5. Mechanism and Machine Theory by J.S.Rao and R.V.Dukipatti, New Age International
6. Theory of Mechanisms and Machines by C.S.Sharma and K.Purohit, PHI
6. Theory of Machines by R.S.Khurmi and J.K.Gupta, S.Chand Publication
7. Theory of Machines by Shah Jadwani, Dhanpat Rai
8. A Textbook of Theory of Machines by R. K. Bansal, Laxmi Publication
9. Theory of Machines by Abdulla Shariff, Dhanpat Rai Publishers
10. Theory of Machines by Sadhu Singh, Pearson Education.

PCME4303 **DESIGN OF MACHINE ELEMENTS** (3-0-0)

[Only specified data book as mentioned in the syllabus is permitted during examination]

Module-I (**12 hours)**

Stages in design, Standardization, Interchangeability, Preferred numbers, Fits and Tolerances, Engineering materials, Ferrous, Non-ferrous, Non-metals, Indian standard specifications for Ferrous materials, Fundamentals of Machine Design, Allowable stress, Factor of safety, Use of Code/Data books.

Design of Joints: Riveted joints, Boiler joints, Welded and bolted joints based on different types of loading. Illustrative problems with solutions.

Module-II (14 hours)

Design of Cotter joints with socket and spigot, with a Gib. Design of knuckle joint. Illustrative problems with solutions.

Design of shafts, solid and hollow based on strength and on rigidity. Illustrative problems with solutions.

Design of keys and pins, Suck key, Feather key, Taper pin. Illustrative problems with solutions.

Design of shaft couplings : Rigid Flange coupling, Flexible Flange coupling.

Module-III (14 hours)

Design of circular section, Helical springs, Tension and compression types, Design of leaf springs: Cantilever and semi-elliptical types. Illustrative problems with solutions. Levers, classification, Design of Foot levers, Hand lever, Cranked lever, Lever of lever loaded – safety - valve. Design of belt and pulley Power screw design with square thread, such as screw jack. Illustrative problems with solutions.

TEXT BOOKS:

1. Mechanical Engineerng Design, J.E.Shigley, C.R.Mischke, R.G.Budynas and K.J.Nisbett, TMH
2. Machine Design, P.Kanaiah, Scietech Publications

REFERENCE BOOKS:

1. Design of Machine Elements, V.B. Bhandari, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2nd Edition 2007.
2. Machine Design, P.C.Sharma and D.K.Agrawal, S.K.Kataria & Sons
3. Machine Design, Pandya and Shah, Charotar Book Stall
4. Machine Design**,** Robert L. Norton, Pearson Education Asia, 2001.
5. Machine Design, A CAD Approach: Andrew D Dimarogonas, John Wiley Sons, Inc, 2001.
6. Fundamentals of Machine Component Design, Robert C. Juvinall and Kurt M Marshek, Wiley India Pvt. Ltd., New Delhi, 3rd Edition, 2007
7. A Text Book of Machine Design, R.S.Khurmi and J.K.Gupta, S.Chand Publication
8. Machine Design, H.Timothy and P.E.Wentzell, Cengage Learning
9. Computer Aided Analysis and Design, S.P.Regalla, I.K.International Publishing

DESIGN DATA HAND BOOKS:

1. P.S.G.Design Data Hand Book**,** PSG College of Tech Coimbature
2. Design Data Hand Book**,** K. Lingaiah, McGraw Hill, 2nd Ed. 2003.
3. Design Hand Book by S.M.Jalaluddin ; Anuradha Agencies Publications

PCME4304 **MACHINING SCIENCE & TECHNOLOGY** (3-0-0)

Module – I **(13 hours)**

Geometry of cutting tools in ASA and ORS, Effect of Geometrical parameters on cutting force and surface finish, Mechanics of chip formation, Merchant's theory, Force relationship and velocity relationship, Cutting tool materials, Types of Tool Wear: Flank wear, Crater wear, Wear measurement, Cutting fluid and its effect; Machinability Criteria, Tool life and Taylor's equation, Effect of variables on tool life and surface finish, Measurement of cutting force, Lathe tool dynamometer, Drill tool dynamometer. Economics of machining.

Module – II **(13 hours)**

Conventional machining process and machine tools – Turning, Drilling, Shaping, Planning, Milling, Grinding. Machine tools used for these processes, their specifications and various techniques used.

Principles of machine tools : Kinematics of machine tools, speed transmission from motor to spindle , speed reversal mechanism, mechanism for feed motion, Tool holding and job holding methods in different Machine tools, Types of surface generated, Indexing mechanism and thread cutting mechanism, Quick return mechanism,.

Production Machine tools – Capstan and turret lathes, single spindle and multi spindle semiautomatics, Gear shaper and Gear hobbing machines, Copying lathe and transfer machine

Module – III **(10 hours)**

Non-traditional Machining processes :

Ultrasonic Machining, Laser Beam Machining, Plasma Arc Machining, Electro Chemical Machining, Electro Discharge Machining, Wire EDM , Abrasive Jet Machining

Text Books :

1. Fundamentals of Machining and Machine Tools, G.Boothroyd and W.A.Knight, CRC Press
2. Metal Cutting Principles, M.C.Shaw, Oxford University Press
3. Metal Cutting Theory and Practice, A.Bhattacharya, Central Book Publishers

Reference Books :

1. Manufacturing Technology – by P.N.Rao, Tata McGraw Hill publication.
2. Modern Manufacturing Processes, P.C.Pandey, H.S.Shan, Tata McGraw Hill
3. Manufacturing Science, Ghosh and Mallik, East West Press.
4. Metal Cutting Theory and Practice, D.A.Stephenson and J.S.Agapiou, CRC Press
5. Machining Technology; Machine Tools and Operation, H.A.Youssef and H. El-Hofy, CRC Press
6. Machine Tools and Manufacturing Technology, Krar, Rapisarda and Check, Cengage Learning
7. Technology of Machine Tools, Krar, Gill and Smidt, Tata McGraw Hill
8. Principles of Metal Cutting, G.Kuppuswamy, Universities Press
9. Metal Cutting and Machne Tools, G.T.Reddy, Scitech
10. Fundamentals of tool Engineering Design, S.K.Basu, S.K.Mukherjee, R. Mishra , Oxford & IBH Pub Co.
11. Machine Tools, R.N.Datta, New Central Book Agency

PCME4302 **IC ENGINES & GAS TURBINES** (3-0-0)

Module - I **(11 hours)**

Introduction :

Classification, Engine nomenclature, engine operating and performance parameters, Valve timing diagram of SI & CI Engines, Comparison of SI and CI engine.

Modern developments in IC Engines, EGR, MPFI, CRDI, GDI, HCCI, dual fuel engine, Lean burn engine, Stratified engine (basic principles).

Thermodynamic Analysis of cycles :

Significance of Fuel-Air & Actual cycles of I.C. engines. Comparison with Air Standard Cycles. Analysis of Fuel-Air & Actual cycles (Effect of chemical equilibrium and variable specific heats. Effect of air fuel ratio and exhaust gas dilution. Time Loss Factor, Heat Loss Factor, Exhaust Blow down, Loss Due to Gas Exchange Processes, Volumetric Efficiency, Loss due to Rubbing Friction)

Fuels : Fuels of SI and CI engine, Fuel additives, Properties, potential and advantages of alternative liquid and gaseous fuels for SI and CI engines (biofuels, LPG and CNG)

Fuel Induction Techniques in IC engines :

Fuel induction techniques in SI and CI engines, Mixture Requirements at Different Loads and Speeds.

Carburetion: Factors Affecting Carburetion, Principle of Carburetion, Simple Carburetor and its drawbacks, Calculation of the Air–Fuel Ratio, Modern Carburetors.

Module II **(15 hours)**

Fuel Injection: Functional Requirements of an Injection System, Classification of Injection Systems, Fuel Feed Pump, Injection Pump, Injection Pump Governor, Mechanical Governor, Pneumatic Governor, Fuel Injector, Nozzle, Injection in SI Engine, Electronic Injection Systems Multi-Point Fuel Injection (MPFI) System, Functional Divisions of MPFI System, Injection Timing, Group Gasoline Injection System, Electronic Diesel Injection System.

Ignition : Energy requirement for ignition, requirements of an ignition system, conventional ignition systems, modern ignition systems (TCI and CDI), firing order, Ignition timing, Spark advance mechanism,

Combustion : Stages of combustion in SI and CI engines, effects of engine variables on flame propagation and ignition delay, Abnormal combustion, Preignition & Detonation, Theory of Detonation. Effect of engine variables on Detonation, control of Detonation. Diesel Knock & methods to control diesel knock, Requirements of combustion chambers. Features of different types of combustion chambers system for S.I. engine. (I-head, F-head combustion chambers), C.I. engine combustion chambers - Open and divided type, Air swirl turbulence-M. type combustion chamber. Comparison of various types of combustion chambers.

Super Charging & Scavenging : Thermodynamics Cycles of supercharging. Effect of supercharging, Efficiency of supercharged engines. Methods of super charging, supercharging and scavenging of 2-stroke engines.

Module-III **(14 hours)**

Testing and Performances : Power, fuel & air measurement methods, Performance characteristic curves of SI & CI engines, variables affecting performance and methods to improve engine performance.

Cooling & Lubricating Systems, Engine Emission & Controls : Air cooling & water cooling systems, Effect of cooling on power output & efficiency, Properties of lubricants and different types of lubricating system.

Engine Emission and control :
Mechanism of pollutant formation and its harmful effects. Methods of measuring pollutants and control of engine emission.
Gas Turbines : Introduction, Open and closed cycle gas turbines, Analysis of practical gas turbine cycle.
Air Craft Propulsion : Analysis of Turbo Jet, Turbo Prop, Turbo fan & Ram jet engines.
Axial Flow & Centrifugal Compressor : Basic construction of centrifugal and axial flow compressor, Velocity diagram, performance characteristics of centrifugal and axial flow compressor, effects of slip, surging and stalling on compressor.

Text Books:
1. Internal Combustion Engines, V. Ganesan, TMH, 3rd edition
2. Gas Turbines, V.Ganesan, TMH, 3rd edition

Reference books:
1. IC Engines, Mathur & Sharma
2. Fundamentals IC Engines, J.B.Heywood, McGraw Hill
3. A course in IC Engines, V.M.Domkundwar, Dhanpat rai and sons
4. Gas Turbines, Cohen and Roser
5. An Introduction to Energy Conversion, Vol.III, V.Kadambi and Manohar Prasad, New Age International
6. Fundamentals of Internal Combustion Engines, H.N.Gupta, PHI
7. Internal Combustion Engines, K.K.Ramalngam, Scitech Publications

Professional Elective-I

PEME5301 **AUTOMOBILE ENGINEERING** (3-0-0)

Module I **(14 hours)**

Introduction
Main units of automobile chassis and body, different systems of the automobile, description of the main parts of the engine, motor vehicle act.

Power for Propulsion
Resistance to motion, rolling resistance, air resistance, gradient resistance, power required for propulsion, tractive effort and traction, road performance curves.

Breaking systems
Hydraulic breaking system, breaking of vehicles when applied to rear, front and all four wheel, theory of internal shoe brake, design of brake lining and brake drum, different arrangement of brake shoes, servo and power brakes.

Module II **(12 hours)**

Transmission Systems
Layout of the transmission system, main function of the different components of the transmission system, transmission system for two wheel and four wheel drives. Hotchkiss and torque tube drives.
Gear box : Sliding mesh, constant mesh and synchromesh gearbox, design of 3 speed and 4 speed gear box, over drive, torque converter, semi and fully automatic transmission.
Hookes joint, propeller shaft, differential, rear axles, types of rear axles, semi floating, there quarter floating and full floating types.

Module III **(14 hours)**

Front wheel Geometry and steering systems : Camber, castor, kingpin inclination, toe-in and toe-out, centre point steering condition for true rolling, components of steering mechanism, power steering.

Electrical system of an automobile : Starting system, charging system, ignition system, other electrical system.

Electrical vehicles:

History, electrical vehicles and the environment pollution, description of electric vehicle, operational advantages, present EV performance and applications, battery for EV, Battery types and fuel cells, Solar powered vehicles, hybrid vehicles.

Textbooks :

1. Automobile Mechanics , N.K.Giri, Khanna publishers
2. Automobile Engineering, K.M. Gupta, VolI & II, Umesh Publication

Reference Books

1. Automotive mechanics: William h. Crouse and Donald L. Anglin, TMH
2. The motor vehicle, Newton and Steeds
3. Automobile Mechanics, J. Heitner, East West Press
4. Automobile Engineering, Jain and Asthana, Tata McGraw Hill
5. Automobile Engineering, K.K.Ramalingam, Scitech
6. Automobile Engineering, Vol. I & II, Kirpal Singh, Standard Publications
7. A Text Book of Automobile Engineering, R.K.Rajput, Laxmi Publishers

PEME5302 **COMPUTER AIDED DESIGN AND COMPUTER AIDED MANUFACTURING** (3-0-0)

Module I **(11 hour)**

Fundamentals of CAD: Design process, Applications of computer for design, Creating the Manufacturing Database, The Design workstation, Graphical Terminal, Operator input Devices, Plotters and other devices, Central Processing Unit, Memory types.

Module II **(11 hour)**

Computer graphics Software and Database: Configuration, Graphics Packages, Constructing the Geometry, Transformations of geometry, Database structure and content, Wire frame versus solid modeling, Constraint– Based modeling, Geometric commands, Display control commands, Editing.

Module III **(14 hour)**

CAM - Numerical Control and NC Part Programming: Numerical Control, Numerical Control elements, NC Cordinate system, NC motion control system, Manual and Computer Aided programming, the APT language, Miscellaneous Functions, M, Advanced part-programming methods.

Problems with conventional NC, NC technology: CNC, DNC, Combined DNC/ CNC system, Adaptive control manufacturing systems, Computer Integrated Manufacturing system, Machine Tools and related equipment, Materials Handling system: AGV, Robots, Lean manufacturing.

Text Books

1. CAD/CAM Computer Aided Design and Manufacturing, M.P.Goover and E.W.Zimmers, Jr., Pearson

Reference Books

1. CAD/CAM Theory and Practice, Zeid and Subramanian, TMH
2. CAD/CAM Principles, Practice and Manufacturing Management, McMahon and Browne, Pearson Education
3. CAD/CAM Concepts and Applications, C.R.Alavala, PHI
4. Computer Aided Design and Manufacturing, Lalit Narayan, Mallkarjuna Rao and Sarcar, PHI
5. CAD/CAM Theory and Conepts, K.Sareen and C.Grewal, S.Chand Publication
6. CAD/CAM/CAE, N.K.Chougule, Scitech
7. Principle of Interactive Computer Graphics, W.W.Newman, R.F.Sproull, TMH

PEME5304 **TRIBOLOGY** (3-0-0)

Module - I **(12 hours)**

Introduction : Lubricant and lubrication, Types of bearings, properties and testing of lubricants,

Basic equations: Generalized Reynolds equation, Flow and Shear Stress, Energy equation, Equation of state

Hydro dynamic lubrication :

Mechanism of pressure development and load carrying capacity, Plane-slider bearing, Idealized slider bearing with a pivoted shoe, Step bearing, Idealized journal bearing. – infinitely long journal bearing, Petroffs equation for a lightly loaded bearing, narrow bearing,

Module - II **(11 hours)**

Oil flow and thermal equilibrium - Heat balance of lubricants

Hydrostatic Bearing **:**

Principles, Component of hydrostatic lubrication , Hydrostatic circular thrust bearing , calculation of pressure, load carrying capacity, flow rate , power loss in bearing due to friction.

Module - III **(12 hours)**

Concept of gas lubricated bearing

Concept of Elastohydrodynamic lubrication, Design and selection of antifiction bearing

Friction and wear of metals :

Theories of friction, surface contaminants, Effect of sliding speed on friction, classification and mechanism of wear, Wear resistant materials.

Text Books

1. Introduction to Tribology of Bearing , B.C .Majumdar , S. Chand & Co

Reference Books

1. Fundamentals of Tribiology , Basu S K., Sengupta A N., Ahuja B. B., , PHI 2006
2. Basic Lubrication theory, A. Cameron, John Wiley & sons
3. Lubrication Fundamentals, D.M.Pirro and A.A.Wessol, CRC Press
4. Theory and Practice of Lubrication for Engineers**,** Fuller, D., New York company 1998
5. Principles and Applications of Tribiology**,** Moore, Pergamaon press 1998
6. Tribiology in Industries**,** Srivastava S., S Chand and Company limited, Delhi 2002
7. Lubrication of bearings – Theoretical Principles and Design**,** Redzimovskay E I., Oxford press company 2000

PEME5303 **RAPID PROTOTYPING** (3-0-0)

Module – I **(12 hours)**

Product Development: Classification of manufacturing processes, Different manufacturing systems, Introduction to rapid Prototyping (RP), Need of RP in context to batch production, FMS and CIM and its application. Product prototyping – solid modeling and prototype representation, reverse engineering, prototyping and manufacturing using CNC machining.

Basic principles of RP steps in RP, Process chain in RP in integrated CAD-CAM environment, Advantages of RP

Module - II **(12 hours)**

Rapid Manufacturing Process Optimization: factors influencing accuracy. Data preparation errors, Part building errors, Error in finishing, influence of build orientation.

Classification of different RP techniques based on raw materials, layering technique (2D or 3D) and energy sources.

Process technology and comparative study of stereo lithography (SL) with photopolymerisation, SL with liquid thermal polymerization, solid foil polymerization, selective laser sintering, selective powder binding, Ballastic particle manufacturing – both 2D and 3D, Fused deposition modeling, Shape melting

Module – III **(12 hours)**

Laminated object manufacturing solid ground curing, Repetitive masking and deposition.

Beam interference solidification, Holographic interference solidification special topic on RP using metallic alloys, Programming in RP modeling, Slicing, Internal Hatching, Surface skin films, support structure.

Software for RP: STL files, Overview of Solid view, magics, imics, magic communicator, etc. Internet based software, Collaboration tools.

Text Book :

1. Rapid Prototyping and Engineering Applications, Frank W. Liou, CRC Press
2. Introduction to Rapid Prototyping, Amitav Ghosh, North West Publication, New Delhi

Reference Books :

1. Rapid Manufacturing, Flham D.T & Dinjoy S.S Verlog London 2001.
2. Rapid Prototyping Materials, Gurumurthi, IISc Bangalore.
3. Rapid Automated, Lament wood. Indus press New York
4. Stereo Lithography and other RP & M Technologies**,** Paul F. Jacobs: SME, NY 1996.
5. Rapid Prototyping**,** Terry Wohlers Wohler's Report 2000" Wohler's Association 2000.

Free Elective – II

FESM6302 **ADVANCE NUMERICAL METHODS** (3-0-0)

Unit-I :
Interpolation: Piecewise Linear Interpolation, Piecewise Quadratic Interpolation, Piecewise Cubic Hermite Interpolation, Piecewise Spline Interpolation.
Numerical Differentiation: First Derivative, Higher Derivatives, Partial Derivative, Richardson's Extrapolation.
Romberg algorithm for numerical integration.

Unit-II
Eigen values and Eigen Vectors: Basic power method, Rayleigh Quotient, Shifted power method, Accelerating convergence, Inverse power method, Basic QR method, Better QR method, Finding eigen vectors, Accelerating convergence
Fourier methods: Discrete Fourier Transforms, Fast Fourier Transforms, Matrix form of FFT, Algebraic form of FFT, Mixed-Radix FFT

Unit-III
Ordinary Differential Equations: Adams-Bashforth Methods, Adams-Moulton Methods, Adams Predictor-Corrector methods, Other Predictor-Corrector methods (Simpson's method and Milne's method)
Parabolic Partial Differential Equation: Explicit Method, Implicit method, Crank-Nicolson method
Hyperbolic Partial Differential Equation: Explicit Method, Implicit method.
Elliptic Partial Differential Equation: Finite-Element method.

Text Book:

1. L.V. Fausett," Applied Numerical Analysis Using MATLAB", Pearson Education

Reference Books:

1. W.Cheney and D. Kincaid,"Numerical Mathematics and Computing", Fifth Edition, Thomson/CENGAGE Learning
2. S. C. Chapra, "Applied numerical methods with MATLAB", second edition, Tata McGraw Hills
3. R.J. Schilling and S.L.Harris,"Applied Numerical Methods for Engineering", CENGAGE learning

PCEC4301 **MICROPROCESSORS** (3-0-0)

Unit I:

Organization of Microprocessor

Introduction to the general concept of microprocessor organization, I/O sub-systems, programming the system, ALU, instruction execution, instruction word format, addressing modes, address/data/control bus, tristate bus, interfacing I/O devices, data transfer schemes, architectural advancements of microprocessor, evolution of microprocessors.

Unit II:

Intel 8086- Hardware Architecture:

Introduction, Bus interface unit(BIU), Execution unit(EU), pin description, register organization, instruction pointer, data register, pointer and index registers, status register, stack, external memory addressing, bus cycle (minimum mode):memory or I/O read/write for minimum mode, clock generator Intel- 8284A, bidirectional bus trans-receiver 8286/8287, bus controller 8288, bus cycle memory read/write for minimum mode, 8086 system configuration (minimum mode as well as maximum mode), memory interfacing, interrupt processing; software interrupts, single step interrupt, non-maskable interrupt, maskable interrupt, interrupt priority, DMA, Halt State, Wait for Test state, comparison between 8086 an 8088.

Unit III:

Instruction set and programming:

Programmer's model of Intel 8086, operand type, addressing modes 8086 assembler directives, instruction set, programming examples on data transfer group, arithmetic-logical groups, control transfer groups (loop and loop handling instruction), conditional and unconditional group, procedures and stack operations, string instructions.,branch program structure like IF-THEN-ELSE REPEAT-UNTIL and WHILE-DO,

I/O Interfacing ;

8-bit input- output port 8255 PPI, memory mapped i/o ports,8254 programmable Interval Timer, 8273 Programmable Direct Memory Access Controller, 8251 USART, 8279 Programmable Keyboard/Display Controller.

Text Books:

1.The 8088 and 8086 Microprocessors Programming, Interfacing, Softw, Hardware and Application; by Walter A. Triebel & Avtar Singh ; Pearson India.

2. Microprocessors and Interfacing; by Douglas V Hall ; McGraw Hill.

Reference Book:

1. Microprocessors and Micro controllers Architecture, programming and system Design 8085, 8086, 8051, 8096: by Krishna Kant; PHI.

2. The 8086 Microprocessor: Programming & Interfacing the PC- Kenneth J. Ayala, Delmar Cengage Learning, Indian Ed.

FEME6302 **PROJECT MANAGEMENT** (3-0-0)

Module-I Project Management Concepts and Needs Identification

Attributes of a Project, Project Life Cycle, The Project management Process, Benefits of Project Management, Needs Identification, Project Selection, Project organization, the project as part of the functional organization.
Project feasibility Analysis: Technical feasibility, commercial and financial visibility, Environment Analysis.

Module-II Project Planning and Scheduling:

Design of project management system; project work system; work breakdown structure, project execution plan, work packaging plan, project procedure manual; project scheduling;
bar charts, line of balance (LOB) and Network Techniques (PERT / CPM)/ GERT, Resource
allocation, Crashing and Resource Sharing, capacity planning and expansion capacity decision.

Module III Project Monitoring and Control and Project Performance
Planning, Monitoring and Control; Design of monitoring system; Computerized PMIS (Project Management Information System). Coordination; Procedures, Meetings, Control;
Scope/Progress control, Performance control, Schedule control, Cost control, Performance
Indicators; Project Audit; Project Audit Life Cycle, Responsibilities of Evaluator/ Auditor, Responsibilities of the Project Manager.

Books:

1. Project Planning, Analysis, Selection, Financing, Prasana Chandra, TMH
2. Project Management, Grey, TMH.
3. Project Management, Richman, PHI
4. Project Management, Vasant Desai, HPH
5. Project Management, Bhavesh M.Patel, Vikash
6. Project Engineering & Management- Prasanna Chandra, Prentice Hall.

PCBM4301 **Elements of Biomedical Instrumentation** (3-0-0)

Module I (13 Hours)

(i) What is bioengineering: Engineering versus Science, Bioengineering, Biochemical Engineering, Biomedical Engineering, and Career Opportunities.

(ii) Medical Instrumentation: Sources of Biomedical Signals, Basic medical Instrumentation system, Performance requirements of medical Instrumentation system, use of microprocessors in medical instruments, PC based medical Instruments, general constraints in design of medical Instrumentation system & Regulation of Medical devices.

(iii) Bioelectrical Signals & Electrodes: Origin of Bioelectric Signals, Electrocardiogram, Electroencephalogram, Electromyogram, Electrode-Tissue Interface, Polarization, Skin Contact Impedance, Motion Artifacts.

(Text Book-I-Chapter-0 , Text Book-II —Chapter-1, Text book-II- Chapter-2)

Module -II (14 Hours)

(iv) Electrodes for ECG: Limb Electrode, Floating Electrodes, Prejelled disposable Electrodes, Electrodes for EEG, Electrodes for EMG.

(v) **Physiological Transducers:** Introduction to Transducers, Classification of Transducers, Performance characteristics of Transducers, Displacement, Position and Motion Transducers.

(Text book-II- Chapter-2 , Text Book-II, Chapter- 3)

Module –III (13 Hours)

(vi) **Physiological Transducers:** Strain gauge pressure transducers, Thermocouples, Electrical Resistance Thermometer, Thermister, Photovoltaic transducers, Photo emissive Cells & Biosensors or Biochemical sensor

(vii) Recording Systems: Basic Recording systems, General considerations for Signal conditioners, Preamplifiers, Differential Amplifier, Isolation Amplifier, Electrostatic and Electromagnetic Coupling to AC Signals, Proper Grounding (Common Impedance Coupling)

(Text Book-II, Chapter- 3, Text Book-II-Chapter-4)

Text Books:-

I- Introduction to Biomedical Engineering by Michael M. Domach, Pearson Education Inc,-2004

II- Hand Book of Biomedical Instrumentation-2nd Ed by R.S.Khandpur, Tata McGraw Hill, 2003.

Reference Books:

1) Introduction to Biomedical equipment technology, 4e. By JOSEPH.J.CAAR

& JOHN.M.BROWN (Pearson education publication)
(2) Medical Instrumentation-application & design. 3e – By JOHN.G.WEBSTER John Wiley & sons publications
(3) Leslie. Cromwell – Biomedical instrumentation & measurements, 2e PHI
(4) Dr. M. Arumugam – Biomedical instrumentations, Anuradha Publishers

PCIT4303 **JAVA Programming** (3-0-0)

Module – I **12 Hrs**

Introduction to Java and Java programming Environment. Object Oriented Programming. Fundamental Programming Structure: Data Types, variable, Typecasting Arrays, Operators and their precedence.

Control Flow: Java's Selection statements (if, switch, iteration, statement, while, do-while, for, Nested loop).

Concept of Objects and Classes, Using Exiting Classes building your own classes, constructor overloading, static , final, this keyword .

Inheritance: Using Super to Call Super class constructor, Method overriding, Dynamic method Dispatch, Using Abstract Classes, Using final with inheritance. The Object Class.

Packages & Interfaces : Packages, Access Protection, Importing package, Interface, Implementing Interfaces, variables in Interfaces, Interfaces can be extended.

Exception Handling: Fundamentals, Types Checked , Unchecked exceptions, Using try & catch, Multiple catch, throw , throws, finally, Java's Built in exceptions, user defined exception.

Module - II **12 Hrs**

Multi Threading: Java Thread Model, Thread Priorities, Synchronization, Creating a thread, Creating Multiple threads, Using isAlive ( ) and join ( ), wait () & notify ( ).

String Handling: String constructors, String length, Character Extraction, String Comparison, Modifying a string.

Java I/O: Classes & Interfaces, Stream classes, Byte streams, Character streams, Serialization.

JDBC: Fundamentals, Type I, Type II, Type III, Type IV drivers.

Networking: Basics, Socket overview, Networking classes, & interfaces, TCP/IP client sockets, whois, URL format, URL connection, TCP/IP Server Sockets.

Module - III **12 Hrs**

Applets: Basics, Architecture, Skeleton, The HTML APPLET Tag, Passing Parameters to Applets, Applet context and show documents ().

Event Handing: Delegation Event model, Event Classes, Event Listener Interfaces, Adapter classes.

AWT: AWT Classes window fundamentals, component, container, panel, Window, Frame , Canvas, Creating a frame window in an Applet , working with Graphics , Control Fundamentals , Layout managers, Handling Events by Extending AWT components.

Core java API package, reflection, Remote method Invocation (RMI)

Swing: J applet, Icons & Labels, Text fields, Buttons, Combo boxes, Tabbed panes, Scroll panes, Trees, Tables.

Exploring Java-lang: Simple type wrappers, Runtime memory management, object (using clone () and the cloneable Interface), Thread, Thread Group, Runnable.

Text Books:

1. Introduction to Java Programming: Liang, Pearson Education, 7th Edition.

2. Java The complete reference: Herbert Schildt, TMH, 5th Edition.

Reference Books:

1. Balguruswamy, Programming with JAVA, TMH.
2. Programming with Java*:* Bhave &. Patekar, Pearson Education.
3. Big Java: Horstman, Willey India, 2nd Edition.
4. Java Programming Advanced Topics: Wigglesworth, Cengage Learning.
5. Java How to Program: H.M. Deitel & Paul J. Deitel, PHI, 8th Edition

PCME7302 **PRODUCTION AND I. C. ENGINE LAB** (0-0-3)

Production Laboratory (Minimum 06 experiments)

1. Determination of grain size, clay content, permeability and green compressive strength of molding sand. (2 to 3 experiments)
2. Foundry Practice
3. Determination of strength of brazed and soldered joints.
4. Study of non-traditional machining process (ultrasonic machining/ abrasive jet machining/ electro-discharge machining)
5. Determination of cutting forces in turning using lathe tool dynamometer
6. Determination of cutting forces in drilling using drilling tool dynamometer
7. Study on C. N.C. Machines and demonstration of making of job through CNC machine.
8. Calibration of slip gauge using sine bar
9. Measurement of roughness / straightness / flatness of surfaces
10. Study of microstructure of steel specimen

I. C. Engine Laboratory **(Minimum 04 experiments)**

1. Load test on 4-stroke single cylinder C.I. engine.
2. Load test on 4-stroke single cylinder S.I. engine.
3. Morse Test on multi-cylinder S.I. or C.I. engine
4. Load test on variable compression ratio S.I. engine
5. Load test and Heat balance on 2 stroke S.I. Engine

PCME7301 **MACHINE DYNAMICS & HEAT POWER LAB** (0-0-3)

Machine Dynamics Laboratory (Minimum 06 experiments)

1. Experiment on Rope brake / Band brake dynamometer
2. Experiment on Epicyclic gear train
3. Determination of gyroscopic couple using gyroscopic test rig.
4. Performance characteristics of a spring loaded governor
5. Determination of critical speed of rotating shaft
6. Experiment on static and dynamic balancing apparatus
7. Determination of natural frequencies of un-damped as well as damped vibrating systems.
8. Study of interference and undercutting for gear drives
9. Experiment on Cam Analysis Apparatus.

10. Experiment on Journal Bearing Apparatus.

Heat Power (Automobile) Laboratory **(Minimum 04 experiments)**

1. Valve timing diagram of an IC engine
2. Study of a modern carburetor (e.g.Solex Carburtor)
3. Study of fuel injection system of a diesel engine
4. Analysis of exhaust gas of automobile
5. Study of different cooling systems in automobiles (Air cooling and water cooling).
6. Study of lubrication systems in automobiles.

PCME7303 **MACHINE DESIGN PROJECT – I** (0-0-3)

1. Assembly drawing of tail-stock of lathe with bill of materials
2. Assembly drawing of screw jack with bill of materials
3. Design & drawing of Riveted joint
4. Design and drawing of Cotter joint
5. Design and drawing of Knuckle joint
6. Design of shafts subjected to combined loading
7. Design and drawing of Flange coupling
8. Design of lever
9. Design and drawing of belt and pulley

Total number of Design : Minimum 6 nos.

Total No. of Drawing : 5 sheets (Two sheets for assembly drawing as per Sl no. 1 and 2 and three sheets for design, under Sl. No. 3, 4, 5, 7 and 9)

6th Semester

HSSM3302 OPTIMIZATION IN ENGINEERING (3-0-0)

Module-I (10 Hours)

Idea of Engineering optimization problems, Classification of optimization algorithms, Modeling of problems and principle of modeling.

Linear programming: Formulation of LPP, Graphical solution, Simplex method, Big-M method, Revised simplex method, Duality theory and its application, Dual simplex method , Sensitivity analysis in linear programming

Module -II (10 Hours)

Transportation problems: Finding an initial basic feasible solution by Northwest Corner rule, Least Cost rule, Vogel's approximation method, Degeneracy, Optimality test, MODI method, Stepping stone method

Assignment problems: Hungarian method for solution of Assignment problems

Integer Programming: Branch and Bound algorithm for solution of integer Programming Problems

Queuing models: General characteristics, Markovian queuing model, M/M/1 model, Limited queue capacity, Multiple server, Finite sources, Queue discipline.

Module -III (10 Hours)

Non-linear programming: Introduction to non-linear programming.

Unconstraint optimization: Fibonacci and Golden Section Search method.

Constrained optimization with equality constraint: Lagrange multiplier, Projected gradient method

Constrained optimization with inequality constraint: Kuhn-Tucker condition, Quadratic programming

Introduction to Genetic Algorithm.

Recommended text books

1. A. Ravindran, D. T. Philips, J. Solberg, *" Operations Research- Principle and Practice*", Second edition, Wiley India Pvt Ltd
2. Kalyanmoy Deb, " *Optimization for Engineering Design*", PHI Learning Pvt Ltd

Recommended Reference books:

1. **S**tephen G. Nash, A. Sofer, *" Linear and Non-linear Programming*", McGraw Hill
2. A.Ravindran, K.M.Ragsdell, G.V.Reklaitis," *Engineering Optimization*", Second edition, Wiley India Pvt. Ltd
3. H.A.Taha,A.M.Natarajan, P.Balasubramanie, A.Tamilarasi, "*Operations Research*", Eighth Edition, Pearson Education
4. F.S.Hiller, G.J.Lieberman, *" Operations Research*", Eighth Edition, TMH.
5. P.K.Gupta, D.S.Hira, "*Operations Research*", S.Chand and Company Ltd.

PCME4307 **ADVANCED MECHANICS OF SOLIDS** (3-0-0)

Module – I **(12 hours)**

Elementary concept of elasticity, stresses in three dimensions, Principal Stresses, Stress Invariants, Mohr's Circle for 3-D state of stress, Octahedral Stresses, State of pure shear, Differential equations of equilibrium and compatibility conditions, plane stress.

Analysis of strain, State of strain at a point, Strain Invariant, Principal Strains, Plane state of strain, Strain measurements.

Theories of Failure, Various yield criteria

Module – II **(14 hours)**

Energy Methods: Work done by forces and elastic strain energy stored. Reciprocal relations, Theorem of virtual work, Castigliano's theorems,

Bending of beams: Asymmetrical bending, Shear centre, Bending of curved beams, Stress distribution in beam with rectangular, circular and trapezoidal cross section, stresses in crane hooks, ring and chain links., Deflection of thick curved bars.

Axisymmetric problems: Thick walled cylinder subjected to internal and external pressures, Compound cylinders, Shrink fit,

Module – III **(10 hours)**

Repeated stresses and fatigue in metals, Fatigue tests and fatigue design theory, Goodman, Gerber and Soderberg criteria, Concept of stress concentration, Notch sensitivity.

Introduction to Mechanics of Composite Materials: Lamina and Laminates, Micromechanics of FRP Composites.

Introduction to Fracture Mechanics: Basic modes of fracture, Fracture toughness evaluation.

Text book:

1. Advanced Mechanics of Solids, L.S. Srinath, Tata McGraw Hill
2. Advanced Mechanics of Materials : Boresi and Schmdt, Willey

Reference book:

1. Advanced Mechanics of Materials : Siley and Smith
2. Strength of Materials Vol.II, by S.Timoshenko
3. Mechanical Metallurgy by Dieter
4. Strength of Materials by G. H. Ryder, Macmillan Press
5. Mechanics of Materials by Beer and Johnston, Tata McGraw Hill
6. Mechanics of Materials by R.C.Hibbeler, Pearson Education
7. Mechanics of Materials by William F.Riley, Leroy D.Sturges & Don H.Morris, Wiley Student.
8. Mechanics of Materials by James M. Gere, Thomson Learning
9. Engineering Machanics of Solids by Egor P. Popov, Prentice Hall of India
10. Strength of Materials by S.S.Rattan, Tata Mc Graw Hill

PCME4306 **DESIGN OF MACHINE COMPONENTS** (3-0-0)

Module I (12 hours)

1. Review of axial, bending and torsional stresses in machine parts; Theories of Failure, Applications in practical problems.
2. Variables stresses (Fatigue), Endurance limit, S - N curve, Fatigue stress concentration factor, Goodman, Gerber and Soderberg criteria, Application to design and practical problems.
3. Design of Pressure vessels : Thin cylindrical and spherical shells, Design of end closures, Thick cylindrical shells, Application to practical problems.

Module II (12 hours)

4 Design of clutch: Friction clutch, Cone clutch and Centrifugal clutch,
5. Design of Brake : Block & Band brake, Internal expanding shoe brake.
6. Design of sliding contact bearings, Journal bearing, foot step bearing
7. Types and selection of ball and roller bearings, Dynamic and static load ratings, Bearing life, Problem illustration.

Module III (12 hours)

8. Design of straight and Helical spur gears, bevel gears.
9. Design of Engine components : Piston, Connecting Rod, Crank Shaft, Flywheel, Illustrative problems with solutions.

DESIGN DATA HAND BOOKS:

1. Design Hand Book by S.M.Jalaluddin ; Anuradha Agencies Publications
2. P.S.G.Design Data Hand Book**,** PSG College of Tech Coimbatore
3. Machine Design Data Book, K.Lingaiah, Tata Mcgraw Hill

TEXT BOOKS:

1. A Text Book of Machine Design, R.S.Khurmi and J.K.Gupta, S.Chand Publication, 14th Edn,
2. Design of Machine Elements, V.B. Bhandari, Tata McGraw Hill Publishing Company Ltd., New Delhi, 3rd Edn

REFERENCE BOOKS:

1. Mechanical Engineerng Design, J.E.Shigley, C.R.Mischke, R.G.Budynas and K.J.Nisbett, TMH
2. Design of Machine Elements, M.F.Spotts,
3. Machine Design, P.C.Sharma and D.K.Agrawal, S.K.Kataria & Sons
4. Machine Design**,** Robert L. Norton, Pearson Education Asia, 2001.
5. Fundamentals of Machine Component Design, Robert C. Juvinall and Kurt M Marshek, Wiley India Pvt. Ltd., New Delhi, 3rd Edition, 2007
6. Machine Design, P.Kanaiah, Scietech Publications

PCME4305 **HEAT TRANSFER (3-0-0)**

Module-I (15 hours)

1. **Introduction:**
   Modes of heat transfer: conduction, convection, and radiation ,Mechanism & basic laws governing conduction, convection, and radiation heat transfer; Thermal conductivity, Thermal conductance &Thermal resistance, Contact resistance, convective heat transfer coefficient, radiation heat transfer coefficient , Electrical analogy, combined modes of heat transfer.initial conditions *and* Boundary conditions of 1st, 2nd and 3rd Kind.
2. **Heat Conduction:**
   The General heat conduction in Cartesian, polar-cylindrical and polar-spherical co-ordinates, Simplification of the general equation for one and two dimensional steady/ transient conduction with constant/ variable thermal conductivity with / without heat generation.
   Solution of the one dimensional steady state heat conduction problem in case of plane walls, cylinders and spheres for simple and composite cases. Critical insulation thickness, Heat transfer in extended surfaces (pin fins) without heat generation, Long fin, short fin with insulated tip and without insulated tip and fin connected between two heat sources. Fin efficiency and fin effectiveness.
   Conduction in solids with negligible internal temperature gradient (Lumped heat analysis).

   Solution of Cartesian problems in two dimensions (steady state conduction with constant thermal conductivity and no heat generation) by variable separation method. Numerical methods for heat conduction analysis.

Module-II (15 hours)

3. **Convective Heat Transfer:**
   (a) Introduction to convective flow - forced and free. Dimensional analysis of forced and free connective heat transfer. Application of dimensional analysis, physical significance of Grashoff , Reynolds, Prandtl, Nusselt and Stanton numbers.
   (b) Conservation equations for mass, momentum and energy for 2-dimensional convective heat transfer in case of incompressible flow, Hydrodynamic and thermal boundary layers for flow over a flat plate. Critical Reynolds number; general expressions for drag coefficient and drag force Reynolds-Colbourn analogy. Thermal boundary layer; general expression for local heat transfer coefficient; Average heat transfer Coefficient; Nusselt number. Flow inside a duct-velocity boundary layer, hydrodynamic entrance length and hydro dynamically developed flow; flow through tubes (internal flow). Use of empirical relations for solving turbulent conditions for external and internal flow.

4. Mechanism of heat transfer during natural convection, Experimental heat transfer correlations for natural convection in the following cases
   (a) Vertical and horizontal plates
   (b) Inside and outside flows in case of tubes

5. **Heat transfer for boiling liquids and condensing vapours :**
   Types of condensation, use of correlations for condensation on vertical flat surfaces, horizontal tube and; regimes of pool boiling, pool boiling correlations. Critical heat flux, concept of forced boiling. Numerical problems.

Module-III (10 hours)

6. **Radiative heat exchange :**
   Introduction, Radiation properties, definitions of various terms used in radiation heat transfer; Absorptivity,reflectivity & transmissivity.Emissive power & emissivity, Kirchoff's identity, Planck's relation for monochromatic emissive power of a black body, Derivation of

Stefan-Boltzmann law and Wien's displacement law from Planck's relation, Radiation shape factor, Relation for shape factor and shape factor algebra. Heat exchange between black bodies through non-absorbing medium. Gray bodies and real bodies, Heat exchange between gray bodies. Radiosity and Irradiation, Electrical analogy and radiation network for 2-body and 3-body radiations exchange in non-absorbing medium, Radiation shields.

7. Heat Exchangers :

Introduction, Types of heat exchanger, The overall heat transfer coefficient and fouling factors, LMTD and - NTU analysis of heat exchangers.

Text Books :

1. Fundamentals of Engineering Heat and Mass Transfer: R.C.Sachdeva, New Age International Publishers, 4th Edition

2. Heat Transfer : J.P.Holman, TMH Publications

3. Basic Heat Transfer by Necati Ozisik, Mcgrawhills Publications

References :

1 Heat Transfer: P.S.Ghosdastidar, Oxford University Press

2. Heat Transfer by P.K. Nag, TMH

3. Heat Transfer by S.P. Sukhatme, TMH

4. Heat Transfer: A.F.Mills and V.Ganesan, Pearson Education, 2nd Edition

5. Heat and Mass Transfer: Domkundwar and Arora, Danpatrai and sons

6. Heat Transfer : R.K.Rajput, Laxmi Publications

7. Heat and Mass Transfer: A Practical Approach, Y.A.Cengel, Tata Macgraw Hills Education Private Limited

PEME5305 **ROBOTICS & ROBOT APPLICATIONS (3-0-0)**

Module – I

1. Fundamentals of Robotics: Evolution of robots and robotics, Definition of industrial robot, Laws of Robotics, Classification, Robot Anatomy, Work volume and work envelope, Human arm characteristics, Design and control issues, Manipulation and control, Resolution; accuracy and repeatability, Robot configuration, Economic and social issues, Present and future application.

2. Mathematical modeling of a robot: Mapping between frames, Description of objects in space, Transformation of vectors.
   Direct Kinematic model: Mechanical Structure and notations, Description of links and joints, Kinematic modeling of the manipulator, Denavit-Hartenberg Notation, Kinematic relationship between adjacent links, Manipulator Transformation matrix.

Module – II

3. Inverse Kinematics: Manipulator workspace, Solvable of inverse kinematic model, Manipulator Jacobian, Jacobian inverse, Jacobian singularity, Static analysis.
4. Dynamic modeling: Lagrangian mechanics, 2D- Dynamic model, Lagrange-Euler formulation, Newton-Euler formulation.
5. Robot Sensors: Internal and external sensors, force sensors, Thermocouples, Performance characteristic of a robot.

Module – III

6. Robot Actuators: Hydraulic and pneumatic actuators, Electrical actuators, Brushless permanent magnet DC motor, Servomotor, Stepper motor, Micro actuator, Micro gripper, Micro motor, Drive selection.
7. Trajectory Planning: Definition and planning tasks, Joint space planning, Cartesian space planning.
8. Applications of Robotics: Capabilities of robots, Material handling, Machine loading and unloading, Robot assembly, Inspection, Welding, Obstacle avoidance.

Text Books:

1. Robotics and Control**,** R.K. Mittal and I.J. Nagrath, Tata McGraw Hill
2. Introduction to Robotics: Mechanics and control, John J Craig, PHI
3. Robotics Technology and Flexible Automation, S.R.Deb and S. Deb, TMH

Reference Books:

1. Introduction to Robotics, S. K. Saha, Tata McGraw Hill
2. Robotics: Control, Sensing, Vision and Intelligence, K.S.Fu, R.C.Gonzalez and C.S.G.Lee, McGraw Hill
3. Robotics, Appuu Kuttan K.K., I.K. international
4. Robot Dynamics and Control, M.W.Spong and M. Vidyasagar , Wiley India.
5. Industrial Robotics Technology, programming and application, M.P.Groover, TMH.
6. Introduction to Robotics: Analysis, Systems, Applications, S.B.Niku, PHI
7. Robotics: Fundamental Concepts and Analysis, A. Ghosal, Oxford University Press
8. Fundamentals of Robotics: Analysis and Control, R. J. Schilling, PHI
9. Robotic Engineering: An Integrated Approach, R.D. KLAFTER, T. A. Chmielewski, and M. Negin, PHI
10. Robot Technology: Fundamentals: J. G. Keramas, Cengage Learning

PEME5306 **MODERN MANUFACTURING PROCESSES** (3-0-0)

Module I **(12 hours)**

ULTRASONIC MACHINING (USM): Introduction, equipment, tool materials & tool size, abrasive slurry, cutting tool system design:- Effect of parameters on Material removal rate, tool wear, Accuracy, surface finish, applications, advantages & Disadvantages of USM.

ABRASIVE JET MACHINING (AJM): Introduction, Equipment, Variables in AJM: Carrier Gas, Type of abrasive work material, stand off distance (SOD), nozzle design, shape of cut. Process characteristics- Material removal rate, Nozzle wear, Accuracy & surface finish. Applications, advantages & Disadvantages of AJM.
Water Jet Machining: Principle, Equipment, Operation, Application, Advantages and limitations of Water Jet machining.

ELECTROCHEMICAL MACHINING (ECM): Introduction, study of ECM machine, elements of ECM process: ECM Process characteristics – Material removal rate, Accuracy, surface finish, Applications, Electrochemical turning, Grinding, Honing, deburring, Advantages, Limitations.

CHEMICAL MACHINING (CHM): Introduction, elements of process, chemical blanking process, process characteristics of CHM: material removal rate, accuracy, surface finish, Hydrogen embrittlement, advantages & application of CHM.

Module II **(13Lectures)**

ELECTRICAL DISCHARGE MACHINING (EDM): Introduction, mechanism of metal removal, dielectric fluid, spark generator, EDM tools (electrodes) Electrode feed control, EDM process characteristics: metal removal rate, accuracy, surface finish, Heat Affected Zone. Machine tool selection, Application, electrical discharge grinding, wire EDM.

PLASMA ARC MACHINING (PAM): Introduction, equipment, non-thermal generation of plasma, selection of gas, Mechanism of metal removal, PAM parameters, process characteristics. Applications, Advantages and limitations.

LASER BEAM MACHINING (LBM): Introduction, equipment of LBM mechanism of metal removal, LBM parameters, Process characteristics, Applications, Advantages & limitations.

ELECTRON BEAM MACHINING (EBM): Principles, equipment, operations, applications, advantages and limitation of EBM.

Module III **(11 Lectures)**

Introduction to Surface engineering, High speed machining and grinding: Application of advanced coatings in high performance modern cutting tools and high performance super-abrasive grinding wheels, Micro and nano machining of glasses and ceramics. Theory and application of chemical processing: Chemical Machining, Aching of semi conductors, Coating and Electroless forming, PVD and CVD; Introduction to Reverse Engineering, Concurrent Engineering and Rapid prototyping:

Text Books:

1. Modern machining process, Pandey and Shan, Tata McGraw Hill 2000
2. Manufacturing Engg. & Technology, Kalpakjian , Pearson Education
3. Manufacturing Science, A.Ghosh & A.K. Mallik, EWP

Reference Books

1. Metals Handbook: Machining Volume 16, Joseph R. Davis (Editor), American Society of Metals.
2. Surface Wear Analysis, Treatment & Prevention - ASM International, Materials Park, OH, U.S.A., 1st Ed. 1995
3. Production Technology, HMT, Tata McGraw Hill. 2001
4. Modern Machining Process, Aditya. 2002
5. Non-Conventional Machining, P.K.Mishra, The Institution of Engineers (India) Test book series, Narosa Publishing House – 2005.
6. Introduction to Rapid Prototyping, A Ghosh, North West Publication

PEME5307 COMPUTER INTEGRATED MANUFACTURING AND FMS (3-0-0)

Module I **(12 hours)**

Fundamentals of Manufacturing and Automation: Production systems, automation principles and its strategies; Manufacturing industries; Types of production function in manufacturing; Automation principles and strategies, elements of automated system, automation functions and level of automation; product/production relationship, Production concept and mathematical models for production rate, capacity, utilization and availability; Cost-benefit analysis.

Computer Integrated Manufacturing: Basics of product design, CAD/CAM, Concurrent engineering, CAPP and CIM.

Module II **(12 hours)**

Industrial Robotics: Robot anatomy, control systems, end effectors, sensors and actuators; fundamentals of NC technology, CNC, DNC, NC part programming; Robotic programming, Robotic languages, work cell control, Robot cleft design, types of robot application, Processing operations, Programmable Logic controllers: Parts of PLC, Operation and application of PLC, Fundamentals of Net workings; Material Handling and automated storage and retrieval systems, automatic data capture, identification methods, bar code and other technologies.

Module III **(12 hours)**

Introduction to manufacturing systems: Group Technology and cellular manufacturing, Part families, Part classification and coding, Production flow analysis, Machine cell design, Applications and Benefits of Group Technology.

Flexible Manufacturing system: Basics of FMS, components of FMS, FMS planning and implementation, flexibility, quantitative analysis of flexibility, application and benefits of FMS.

Computer Aided Quality Control: objectives of CAQC, QC and CIM, CMM and Flexible Inspection systems.

Text Books:

1. Automation, Production Systems and Computer Integrated Manufacturing: M.P. Groover, Pearson Publication.
2. Automation, Production systems & Computer Integrated Manufacturing, M.P Groover, PHI.
3. CAD/CAM/CIM, P.Radhakrishnan, S.Subramanyam and V.Raju, New Age International
4. Flexible Manufacturing Systems in Practice, J Talavage and R.G. Hannam, Marcell Decker

Reference Books:

1. CAD/CAM Theory and Practice, Zeid and Subramanian, TMH Publication
2. CAD/CAM Theory and Concepts, K. Sareen and C. Grewal, S Chand publication
3. Computer Aided Design and Manufacturing, L. Narayan, M. Rao and S. Sarkar, PHI.
4. Principles of Computer Integrated Manufacturing, S.K.Vajpayee, PHI
5. Computer Integrated Manufacturing, J.A.Rehg and H.W.Kraebber, Prentice Hall

PEME5308 NON-CONVENTIONAL ENERGY SOURCES(3-0-0)

Module I (10 Classes)

Energy, Ecology and environment: Introduction, Classification of Energy Resources, Common Forms of Energy, Energy Chain, Advantages and Disadvantages of Conventional Energy Sources, Importance and Salient Features of Non-Conventional Energy Sources, Environmental and ecological Aspects of Energy use, Environment-Economy-Energy and Sustainable Development, World Energy Status, Energy Scenario in India.

Energy Conservation and Energy Storage: Salient Features of "Energy Conservation Act, 2001", Various Aspects of Energy Conservation, Principles of Energy Conservation, General Electrical ECO's (Energy Conservation Opportunities),

Solar Energy: Basics, The Sun as a Source of Energy, Sun, Earth Radiation Spectrums, Extraterrestrial and Terrestrial Radiations, Spectral Energy Distribution of Solar Radiation, Depletion of Solar Radiation, Measurements of Solar Radiation, Solar Time (Local Apparent Time), Solar Radiation Geometry, Solar Day Length, Empirical Equations for Estimating Solar Radiation(Hourly Global, Diffuse and Beam Radiations) on Horizontal Surface Under Cloudless and Cloudy Skies, Solar Radiation on Inclined Plane Surface only (empirical relations for numerical)

Module II (15 Classes)

Solar Thermal Systems: Solar Collectors: Flat plate and concentric collectors, Solar Water Heater, Solar Passive Space - Heating and Cooling Systems, Solar Refrigeration and Air-Conditioning Systems, Solar Cookers, Solar Furnaces, Solar Green House, Solar Dryer, Solar Distillation (or Desalination of Water),

Solar Photovoltaic Systems: Solar Cell Fundamentals, Solar Cell Characteristics, Solar Cell Classification, Solar Cell, Module, Panel and Array Construction, Solar PV Systems, Solar PV Applications.

Wind Energy: Origin of Winds, Nature of Winds, Wind Turbine Siting, Major Applications of Wind Power, Wind Turbine Types and Their Construction, Wind Energy Conversion Systems (WECS), Effects of Wind Speed and Grid Condition (System Integration),

Module III (15 Classes)

Biomass Energy: Photosynthesis Process, Usable Forms of Biomass, their Composition and Fuel Properties, Biomass Resources , Biomass Conversion Technologies, Urban Waste to Energy Conversion, Biomass Gasification ,Biomass Liquefaction, Biomass to Ethanol Production, Biogas Production from Waste Biomass, Energy Farming.

Miscellaneous Non-conventional Technologies

Geothermal Energy: Applications, Origin and Distribution of Geothermal Energy, Types of Geothermal Resource.

Ocean Energy: Tidal Energy, Wave Energy, Ocean Thermal Energy

Fuel Cell Technology: Types, Principle of operation, Advantages and disadvantages.

Text Book:

1. Non Conventional Energy Sources: B.M Khan, TMH Publications
2. Renewable Energy Sources and Emerging Technology: D.P.Kothari and etal., PHI
3. Renewable Energy Sources & Conversion Technology: N.K.Bansal, Manfred Kleenman & Michael Meliss, TMH Publication.

Reference:

1. Renewable Energy Sources:Fundamentals & Applications:G.N.Tiwari & M.K.Ghosal, Narosa Pub
2. Non Conventional Energy Resources: D.S. Chauhan and S.K.Srivastava, New Age International
3. Non Conventional Energy Sources: H.P.Garg
4. Non-Conventional Energy Systems: G.D.Rai, Khanna publications
5. Solar Energy Technology: Sukhatme and Nayak, TMH
6. Renewable Energy, Godfrey Boyle, Oxford University Press

FEME6301 **FINITE ELEMENT METHOD** (3-0-0**)**

Module – I **(12 hours)**

Review of 2-D and 3-D stress analyses, vibration, fluid flow and heat conduction problems.
FEM fundamental concepts, Variational principles, Rayleigh Ritz and Galerkin Methods.
Finite Element Modeling of one dimensional problems.
Finite Element Analysis of 2-D and 3-D framed structures.

Module – II **(12 hours)**

FEM formulation of 2-D and 3-D stress analysis problems.
Axisymmetric solids subjected to axisymmetric loadings.
Two-dimensional isoparametric elements and numerical integration.

Module – III **(12 hours)**

FE modeling of basic vibration problems
Finite element modeling of fluid flow and heat conduction problems
Computer programs: preprocessing and post processing.
Exposure to commercial FE codes such as ANSYS, NASTRAN and IDEAS etc.

Text Books

1. Finite Elements in Engineering, T.R.Chandraputla and A.D.Belegundu, PHI
2. The Finite Element Method – Its Basis & Fundamentals, Zienkiewicz, Taylor and Zhu, Elsevier, 6th Edn

Reference

1. Introduction to Finite Element Method, C.Desai and J.F.Abel, CBS publishers
2. Introduction to Finite Element Method, J.N.Reddy, Tata McGraw Hill
3. Numerical Methods in Finite Element Analysis, K.J.Bathe and E.L.Wilson, PHI
4. Concepts & Applications of Finite Element Analysis,Cook, D.S.Malkus & M.E.Plesha, Wiley
5. The Finite Element Method in Engineering, S.S.Rao, Elsevier
6. A First Course in the Finite Element Method, D.L.Logan, Cengage Learning
7. Fundamentals of Finite Element Analysis, David V. Hutton, Tata McGraw Hill

PCEC4304 **DIGITAL SIGNAL PROCESSING** (3-0-0)

Module – I (10 hours)

The Z-Transform and Its Application to the Analysis of LTI Systems:

The Z-Transform: The Direct Z-Transform, The Inverse Z-Transform; Properties of the Z-Transform; Inversion of the Z-Transforms: The Inversion of the Z-Transform by Power Series Expansion, The Inversion of the Z-Transform by Partial-Fraction Expansion; Analysis of Linear Time-Invariant Systems in the z-Domain: Response of Systems with rational System Functions, Transient and Steady-State Responses, Causality and Stability, Pole-Zero Cancellations.

Selected portions from Chapter 3 (3.1.1, 3.1.2, 3.2, 3.4.2, 3.4.3, 3.5.1, 3.5.2, 3.5.3, 3.5.4) of Textbook – I

The Discrete Fourier Transform: Its Properties and Applications

Frequency Domain Sampling: Frequency-Domain Sampling and Reconstruction of Discrete-Time Signals, The Discrete Fourier Transform, The DFT as a Linear Transformation, Relationship of the DFT to other Transforms; Properties of the DFT: Periodicity, Linearity, and Symmetry Properties, Multiplication of Two DFTs and Circular Convolution, Additional DFT Properties; Linear Filtering Methods Based on the DFT: Use of the DFT in Linear Filtering, Filtering of Long Data Sequences; Frequency Analysis of Signals using the DFT; The Discrete Cosine Transform: Forward DCT, Inverse DCT, DCT as an Orthogonal Transform.

Chapter – 7 of Textbook – 1.

Module – II (10 hours)

Implementation of Discrete-Time Systems:

Structure for the Realization of Discrete-Time Systems, Structure for FIR Systems: Direct-Form Structure, Cascade-Form Structures, Frequency-Sampling Structures; Structure for IIR Systems: Direct-Form Structures, Signal Flow Graphs and Transposed Structures, Cascade-Form Structures, Parallel-Form Structures.

Selected portions from Chapter 9 (9.1, 9.2.1, 9.2.2, 9.2.3, 9.3.1, 9.3.2, 9.3.3, 9.3.4) of Textbook – I

Design of Digital Filters:

General Considerations: Causality and Its Implications, Characteristics of Practical Frequency-Selective Filters; Design of FIR Filters: Symmetric and Antisymmetric FIR

Filters, Design of Linear-Phase FIR Filters by using Windows, Design of Linear-Phase FIR Filters by the Frequency-Sampling Method; Design of IIR Filters from Analog Filters: IIR Filter Design by Impulse Invariance, IIR Filter Design by the Bilinear Transformation.

Selected portions from Chapter 10 (10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.2.3, 10.2.4, 10.3.2, 10.3.3) of Textbook – I

Module- III (15 hours)

Efficient Computation of the DFT: Fast Fourier Transform Algorithms

Efficient Computation of the DFT: FFT Algorithms: Direct Computation of the DFT, Radix-2 FFT Algorithms: Decimation-In-Time (DIT), Decimation-In-Time (DIF); Applications of FFT Algorithms: Efficient Computation of the DFT of two Real Sequences, Efficient Computation of the DFT a 2N-Point Real Sequence, Use of the FFT Algorithm in Linear Filtering and Correlation.

Selected portions from Chapter 8 (8.1.1, 8.1.3, 8.2.1, 8.2.2, 8.2.3) of Textbook – I

Adaptive Filters:

Application of Adaptive Filters: System Identification or System Modeling, Adaptive Channel Equalization, Adaptive Line Enhancer, Adaptive Noise Cancelling; Adaptive Direct-Form FIR Filters-The LMS Algorithm: Minimum Mean Square Error Criterion, The LMS Algorithm.

Selected portions from chapter 13 (13.1.1, 13.1.2, 13.1.5, 13.1.6, 13.2.1, 13.2.2) of Text book –I

Text Books

1. Digital Signal Processing – Principles, Algorithms and Applications by J. G. Proakis and D. G. Manolakis, 4th Edition, Pearson.

Reference Book :

1. Digital Signal Processing: a Computer-Based Approach – Sanjit K. Mitra, TMH.
2. Digital Signal Processing – S. Salivahan, A. Vallavraj and C. Gnanapriya, TMH.
3. Digital Signal Processing – Manson H. Hayes (Schaum's Outlines) Adapted by Subrata Bhattacharya, Tata McGraw Hill.
4. Digital Signal Processing: A Modern Introduction – Ashok Ambardar, Cengage Learning.
5. Modern Digital Signal Processing – Roberto Cristi, Cengage Learning.
6. Digital Signal Processing: Fundamentals and Applications – Li Tan, Academic Press, Elsevier.
7. Digital Signal Processing: A MATLAB-Based Approach – Vinay K. Ingle and John G. Proakis, Cengage Learning.
8. Fundamentals of Digital Signal Processing using MATLAB – Robert J. Schilling and Sandra L. Harris, Cengage Learning.

PCIT4301 **INTERNET AND WEB TECHNOLOGY** (3-0-0)

Module –I (Lecture Hour 12)

The Internet and WWW

Understanding the WWW and the Internet, Emergence of Web, Web Servers, Web Browsers, Protocols, Building Web Sites

HTML

Planning for designing Web pages, Model and structure for a Website, Developing Websites, Basic HTML using images links, Lists, Tables and Forms, Frames for designing a good interactive website

Module –II (Lecture Hour 12)

JAVA Script

Programming Fundamentals, Statements, Expressions, Operators, Popup Boxes, Control Statements, Try…. Catch Statement, Throw Statement, Objects of Javascript: Date object, array object, Boolean object, math object

CSS

External Style Sheets, Internal Style Sheets, Inline Style, The class selector, div & span tag

DOM

HTML DOM, inner HTML, Dynamic HTML (DHTML), DHTML form, XML DOM

Module –III (Lecture Hour 11)

CGI/PERL

Introduction to CGI, Testing & Debugging Perl CGI Script, Using Scalar variables and operators in Perl

Java Applet

Introduction to Java, Writing Java Applets, Life cycle of applet

Textbooks

1. Web Warrior Guide to Web Design Technologies, Don Gosselin, Joel Sklar & others, Cengage Learning

Reference Books

1. Web Programming: Building Internet Applications, Chris Bates, Wiley Dreamtech
2. Programming the World Wide Web, Robert W Sebesta, Pearson
3. Web Technologies, Uttam K Roy, Oxford
4. Web Technology: A developer perspective, Gopalan & Akilandeswari, PHI

PECS5303 **PATTERN RECOGNITION** (3-0-0)

Module –I (Lecture Hour 12)

Introduction

Features, Feature Vectors and Classifiers, Supervised vs. unsupervised pattern

Classifier

Classifier based on Bayes Decision Theory, Linear classifier: Least square methods, Mean square estimation, Support vector machines, nonlinear classifier: Two layer & three layer perceptron, Back propagation algorithm, combining classifiers

Module –II (Lecture Hour 12)

Feature Selection

Preprocessing, Statistical hypothesis testing, Class separability measures

Feature Generation

Linear transforms, Discrete Fourier transform (DFT), Hadamard transform, Discrete Time Wavelet transform (DTWT)

Fourier feature, Moment-based features

Fractals: Self similarity, Fractional Brownian Motion (FBM), Fractal dimension

Module –III (Lecture Hour 11)

Template Matching

Based on optimal path searching techniques, correlations

Clustering

Sequential algorithms: Estimation of number of clusters

Hierarchical algorithms: Agglomerative algorithms

Textbooks

1. Pattern Recognition, Sergios Theodoridis & Konstantinous Koutroumbas, Elsevier

PEIT5301 **E-COMMERCE** (3-0-0)

Module –I (Lecture Hour 11)
Basics of E-commerce
Basic Elements, of e-commerce, e-commerce framework, basic infrastructure for e-commerce: Technical, capital, media, Human Resource, Public policy
Technical Infrastructure
Internet connectivity, protocols, web server, software for web server, e-commerce software, security threats to e-commerce, protecting e-commerce system

Module –II (Lecture Hour 12)
Payment System for E-commerce
Online payments system, pre-paid and post-paid electronic payment systems, Electronic data interchange (EDI)
Business Models for E-commerce
Revenue Model, Business model based on strategies, Marketing on the web: Internet based Advertisement, Website usability, consumer oriented e-commerce

Module –III (Lecture Hour 12)
Internet Business Strategies
Electronic marketplaces, Electronic Auctions, Mobile Commerce, Virtual Communities

Textbooks
1. Ecommerce, Gary P. Schneider, Cengage Learning
2. Electronic Commerce: Framework Technologies & Applications, Bharat Bhasker, TMH

Reference Books
1. Electronic Commerce: A Manager's Guide, Kalakota & Whinston, Pearson
2. E-commerce, Jibitesh Mishra, Macmillan
3. E-commerce: Concepts, models & strategies, C.V.S Murthy, Himalaya Publishing

Heat Transfer and Heat Power Laboratory (0-0-3)

(Minimum 10 experiments with minimum 4 from each group)

Heat Transfer Laboratory

1. Determination of Thermal conductivity of composite slab
2. Determination of heat transfer coefficient in natural/forced convention.
3. Determination of surface emissivity
4. Performance test on parallel flow and counter flow heat exchanger
5. Efficiency and effectiveness of fins (Natural / Forced convection)
6. Determination of Critical heat flux during boiling heat transfer.
7. Verification of Stefan Boltzman's law.

Heat Power Laboratory

1. Performance analysis of reciprocating air-compressor
2. Performance analysis of Centrifugal / Axial Flow compressor
3. Study of steam power plant
4. Study of gas turbine power plant.
5. Determination of performance characteristics of gear pump.
6. Study of power transmission system of automobiles

Numerical Computation & Solids Modeling Lab (0-0-3)

Numerical Computation

(Using MATLAB or other software/language)

1. Basics of MATLAB or similar software/language
2. Finding solution by Numerical Methods (including graphics) for the following: **(Minimum 06 problems)**
   a) Bisection Method
   b) Newton-Raphson Method
   c) Secant Method
   d) Gauss Elimination Method
   e) Numerical Differentiation
   f) Numerical Integration (e.g. Newton Cotes Quadrature)
   g) Curve fitting Method
   h) Initial-Value Problems (e.g. Runge-Kutta Method)
   i) Boundary Value Problem (eg. Shooting Method)
   j) Eigen Value Problem

Solids Modeling

(Using Solid Modeling software eg. AUTOCAD/ProE/CATIA/SolidWorks etc)

1. Learning the Basics of Solid Modeling Software
2. Describe and Apply the CONE, SPHERE and TORUS command to draw solid primitives
3. Describe and Apply the EXTRUDE and REVOLVE command to draw solid models that can not be drawn with a composition of primitives

Books

(i) Applied Numerical Methods with MATLAB, S.C.Chapra, TMH
(ii) Numerical Methods for Engineers and Scientists, J.D.Hoffman, CRC Press
(iii) Numerical Methods, E Balagurusamy, TMH
(iv) Numerical Methods for Engineers, Chapra and Canale, TMH
(v) MATLAB Programming for Engineers, Chapman, Thomson Learning
(vi) Getting Started with MATLAB, Rudra Pratap, Oxford University Press
(vii) Mastering MATLAB 7, Hanselman and Littlefield, Pearson Education

MACHINE DESIGN PROJECT – II (0-0-3)

1. Design of shaft on the basis of theories of failure
2. Design of machine components under dynamic stress
3 Design of thin/ thick cylindrical shells under internal fluid pressure
4. Design of clutch
5. Design of Brake
6. Design of Journal Bearing
7. Design of straight/ helical gears
8. Design of piston
9. Design of connecting rod
10. Design of crank shaft
11. Design of fly wheel

Note : At least 7 to 8 designs with relevant drawings should be carried out. Rest of the design problem can be given as assignments.

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BIJU PATNAIK UNIVERSITY OF TECHNOLOGY, ORISSA

MECHANICAL ENGINEERING

7th Semester

Code	Theory Subjects	L-T-P	Credit
PCME4401	Product Design and Production Tooling	3-0-0	3
PCME4402	Refrigeration & Air Conditioning	3-0-0	3
PCME4403	Mechanical Measurement and Control	3-0-0	3
	Professional Elective - III	3-0-0	3
PEME5401	Mechanical Vibration		
PEME5402	Advanced Fluid Mechanics		
PEME5403	Fluid Power & Control		
PEME5404	Computational Fluid Dynamics		
	Professional Elective-IV	3-0-0	3
PEME5405	Metrology, Quality Control & Reliability		
PEME5406	Simulation Modeling and Control		
PEME5407	Mechatronics		
PEME5408	Composite Materials		
	Free Elective-IV (Any one)	3-0-0	3
FEME6401	Human Resource Managements		
PEEE5407	Industrial Automation & Control		
PEEE5406	Soft Computing		
HSSM3401	Entrepreneurship Development		
	Theory Credits		18
	Practical/Sessional		
PCME7402	Project	0-0-3	3
PCME7403	Seminar - I	0-0-3	2
PCME7401	Refrigeration & Air Conditioning & Mechanical Measurement Lab	0-0-3	2
	Practical/Sessional Credits		**07**
	TOTAL SEMESTER CREDITS		**25**

8th Semester

Code	Theory Subjects	L-T-P	Credit
HSSM3402	Environmental Engineering	3-0-0	3
PCME4404	Production and Operation Management	3-0-0	3
	Professional Elective-V (Any one)	3-0-0	3
PEME5409	Power Plant Engineering		
PEME5410	Fatigue, Creep & Fracture		
PEME5411	Experimental Stress Analysis		
PEME5412	Smart Materials & Structures		
PEME5413	Machinery Fault Diagnostics & Condition Monitoring.		
	Free Elective-V (Any one)	3-0-0	3
PETX5412	Management Information System		
HSSM3403	Marketing Managements		
PECS5407	Wireless Sensor Networks		
PEEI5405	Micro Electro Mechanical Systems(MEMS)		
	Theory Credits		12
	Practical/Sessional		
PCME7404	Project	0-0-3	4
PCME7405	Seminar - II	0-0-3	2
PCME7406	Enterprenurship Project	0-0-3	2
PCME7407	Comprehensive Viva-Voce	0-0-3	2
	Practical/Sessional Credits		**10**
	TOTAL SEMESTER CREDITS		**22**
	TOTAL CUMULATIVE CREDITS		**204**

PRODUCTION DESIGN & PRODUCTION TOOLING

Module I **(8 hours)**

Product design considerations, product planning, product development, value analysis, product specification. Role of computer in product design.

Product design for sand casting: design of gating system and risering.

Module II **(12 hours)**

Forging design: allowances, die design for drop forging, design of flash and gutter, upset forging die design.

Sheet metal working: Design consideration for shearing, blanking piercing, deep drawing operation, Die design for sheet metal operations, progressive and compound die, strippers , stops, strip layout.

Module III **(16 hours)**

Design of jigs and fixtures, principle of location and clamping, clamping methods, locating methods, Drill Jig bushing, Indexing type drilling Jig. Design of single point cutting tool, broach and form tool. Design of limit gauges.

Process Planning – selection of processes, machines and tools. Design of sequence of operations, Time & cost estimation, Tooling design for turret lathe and automats.

Text Books:

1. Fundamentals of Tool Engineering design, S.K. Basu, S.N. Mukherjee, R. Mishra, Oxford & IBH Publishing co.
2. Manufacturing Technology, P.N. Rao , Tata McGraw Hill
3. A Textbook of Production Engineering, P.C. Sharma, S. Chand & Co

Reference Books:

1. Product Design & Manufacturing, A K Chitale, R C Gupta, Eastern Economy Edition, PHI.
2. Product Design & Development, Karl T Ulrich, Steven D Eppinger, Anita Goyal, Mc Graw Hill
3. Technology of Machine Tools, Krar, Gill, Smid, Tata Mc Graw Hill
4. Jigs & Fixture Design, Edwrd G Hoffman, Cengae Learning.

REFRIGERATION & AIR CONDITIONING

Module I (14 hours)

1. Air Refrigeration System : Introduction, Unit of refrigeration, Coefficient of performance, Reversed Carnot Cycle, Temperature limitations, maximum COP, Bell Coleman air cycle, Simple Air Cycle System for Air-craft with problems.
2. Vapour Compression System : Analysis of theoretical vapour compression cycle, Representation of cycle on T - S and p - h diagram, Simple saturation cycle, sub-cooled cycle and super-heated cycle, Effect of suction and discharge pressure on performance, Actual vapour compression cycle. Problem illustration and solution.
3. Multi-stage compression and Multi-evaporator systems : Different arrangements of compressors and inter-cooling, Multistage compression with inter-cooling, Multi-evaporator system, Dual compression system. Simple problems

Module II **(** 13 hours)

4. Vapour Absorption System : Simple Ammonia - absorption system, Improved absorption system, Analysis of vapour absorption system (Specifically of analyzing coloumn and rectifier), Electrolux / Three fluid system, Lithium-bromide-water vapour absorption system, comparison of absorption system with vapour compression system. Simple Problems and solution.
5. Thermoelectric Refrigeration: Basics and Principle. Defining the figure of Merit. (No Problem)
6. Refrigerants ; Classification of refrigerants and its degignation- Halocarbon (compounds, Hydrocarbons, Inorganic compounds, Azeotropes, Properties of refrigerants, comparison of common refrigerants, uses of important refrigerants, Brines. Alternative refrigerants (Organic and inorganic compounds).

Module III (13 hours)

Psychrometrics : Properties of air-vapour mixture, Law of water vapour-air mixture, Enthalpy of moisture, Psychrometric chart, simple heating and cooling, Humidification, De-humidification, Mixture of air streams. Review question and discussions

Requirements of comfort air conditioning : Oxygen supply, Heat removal, moisture removal, air motion, purity of air, Thermodynamics of human body, comfort and comfort chart, effective temperature, factors governing optimum effective temperature

Air Conditioning System : Process in air conditioning : Summer air conditioning, Winter air conditioning and year round air conditioning, Cooling load calculations. Review question and discussions.

Text Books :

1. Refrigeration and Air Conditioning by R.C. Arora , PHI Publication
2. Refrigeration and Air Conditioning by S.C. Arora and S. Domkundwar, Dhanpat Rai & Sons. Chapters ; 3,4,5,6,7,11,16,17,19,20
3. Refrigeration and Airconditioning Data book by Manohar Prasad

Reference Books :

1. Refrigeration and Air conditioning by P.L. Balloney, Khanna Publishers.
2. Refrigeration and Air conditioning by Manohar Prasad,New Age international publishers.
3. Refrigeration and Air conditioning by C.P. Arora, Tata McGraw Hill.

MECHANICAL MEASUREMENT & CONTROL

Module I **(14 hours)**

Introduction to Instruments and their Representation:

Typical Applications of Instrument Systems, Functional Elements of a Measurement System, Brief Description of the Functional Elements of the Instruments, Classification of Instruments, Microprocessor -Based Instrumentation, Standards and Calibration.

Static and Dynamic Characteristics of Instruments:

Static Performance Parameters, Impedance Loading and Matching, Selection and Specifications of Instruments, Dynamic Response, Compensation.

Transducer Elements:

Analog Transducers, Digital Transducers,

Basic detector transducer elements : Electrical transducer, Sliding Contract devices, Variable-inductance transducer elements, the differential transformer, Variable-reluctance transducers, Capacitive transducers. The piezoelectric effect, photo-electric transducer, electronic transducer element.

Intermediate Elements:

Amplifier, Operational Amplifier, Diffential and Integrating Elements, Filters, A-D and D-A Converters

The simple current sensitive circuit, the ballast circuit, The voltage-dividing potentiometer circuit, The voltage balancing potentiometer circuit, Resistance bridges.

Indicating, Recording and Display Elements:

Meter Indicators. The vacuum tube voltmeter, CRO, Electronic Switch, CRO recording techniques, Oscillographs. Digital Recorders

Module II **(12 hours)**

Strain Measurement

The electrical resistance strain gauge. The metallic resistance strain gauge, Selection and Installation factors for metallic strain gauge, Circuitry, metallic strain gauge. The strain gauge ballast circuit, the staring gauge bridge circuit, Temperature compensation.

Measurement of Pressure

Pressure measurement systems, Pressure measurement transducers, Elastic diaphragms, strain gauge pressure cells, measurement of high pressure, Measurement of low pressures, dynamic characteristics of pressure measuring systems.

Measurement of Fluid Flow

Flow characteristics obstruction meters, Obstruction meter for compressible fluids- Orifice, Venturi meter and Pitot tube, The variable-area meter, Turbine Flow meters.

Temperature Measurement

Use of bimetals pressure thermometers, Thermocouples, Pyrometry, Calibration of temperature measuring devices.

Force, Power, Speed and Torque Measurement :

Load Cell, Dynamometers, Tachometer and Tacho-generator, Stroboscope, The seismic instrument.- Vibrometers and accelerometers

Module III **(12 hours)**

Description of open and closed loop control systems and their block diagrams. Use of block diagram and signal flow graph to find overall transfer function.

1^{st} and 2^{nd} order systems and their response to step and sinusoidal input, error analysis, static and dynamic error coefficients.

Routh's stability criterion. The Root-Locus method, Bode Plot and Nyquist plot, Gain margin and phase margin.

Textbooks

1. Instrumentation Measurement and Analysis, B.C.Nakra and KK.Chaudhry, Tata Mc Graw Hill, Third Edition.

Reference :

1. Mechanical Measurements, T.G. Beckwith and N. Lewis Buck, Oxford and IBH Publishing Co.
2. Modern Control Engineering, K.K. Ogata, prentice Hall India

MECHANICAL VIBRATION

Module – I **[12]**

1. INTRODUCTION & IMPORTANCE OF MECHANICAL VIBRATION: Brief history of Mechanical Vibration, Types of Vibration, Simple Harmonic Motion (S.H.M.), Principle of superposition applied to S.H.M., Beats, Fourier Analysis, Concept of degree of freedom for different vibrating systems.
2. UNDAMPED FREE VIBRATION OF SINGLE DEGREE FREEDOM SYSTEMS: Modeling of Vibrating Systems, Evaluation of natural frequency – differential equation, Energy & Rayleigh's methods, Equivalent systems.
3. DAMPED FREE VIBRATION OF SINGLE DEGREE FREEDOM SYSTEMS: Different types of damping, Equivalent viscous damping, structural damping, Evaluation of damping using free and forced Vibration technique, Concept of critical damping and its importance, study of vibration response of viscous damped systems for cases of under damping, critical damping and over damping, Logarithmic decrement.

Module – II **[15]**

4. FORCED VIBRATION OF SINGLE DEGREE FREEDOM SYSTEMS: Steady state solution with viscous damping due to harmonic force, reciprocating and rotating unbalance mass, vibration isolation and transmissibility due to harmonic force excitation and support motion. Vibration measuring instruments – vibrometer and accelerometer. Whirling of shaft with single disc and withour damping, Concept of critical speed and its effect on the rotating shaft.
5. UNDAMPED VIBRATION OF TWO DEGREE FREEDOM SYSTEMS: Free vibration of spring coupled and mass coupled systems, Longitudial, Torsional and transverse vibration of two degree freedom systems, influence coefficient technique, Un-damped vibration Absorber.

Module – III **[13]**

6. INTRODUCTION TO MULTI-DEGREE FREEDOM SYSTEMS: Normal mode vibration, Co-ordinate coupling-close coupled and far coupled systems, Orthogonality of mode shapes, Methods of matrix iteration, Holzer's method and Stodola method. Torsinal vibration of two, three and multi-rotor systems. Dunkerley's lower bound approximate method.
7. CONTINOUS SYSTEMS: Vibration of strings, longitudinal vibration of rods, torsional vibration of rods, transverse vibration of Euler-beams.

Text Books:

1. Theory of vibration with Applications: W.T. Thomson and Marie Dillon Dahleh, Pearson Education 5th ed. 2007.
2. Introductory Course on theory and Practice of Mechanical Vibrations. J.S. Rao & K. Gupta, New Age International Publication, New Delhi, 2007.

Deference Books:

1. Mechanical Vibrations: S.S. Rao, Prarson Education Inc, 4th ed. 2003
2. Mechanical Vibrations: S. Graham Kelly, Schaum's outline series, Tata McGraw Hill, Special Indian ed., 2007
3. Mechanical Vibrations: V.P. Singh, Dhanpat Rai & company Pvt. Ltd. 3rd ed., 2006
4. Elements of vibration Analysis: Leonard Meirovitch, Tata McGraw Hill, Special Indian ed., 2007

ADVANCED FLUID MECHANICS

Module I

Concept of continuum and definition of a fluid. Body and surface forces, stress tensor, Scalar and vector fields, Eulerian and Lagrangian description of flow. Motion of fluid element - translation, rotation and vorticity; strain rate tensor, continuity equation, stream function and velocity potential.

Module II

Transport theorems, constitutive equations, derivation of Navier Stokes equations for compressible flow. Exact solutions of Navier Stokes equations : plane Poiseuille flow and Couette flow, Hagen-Poiseuille flow, flow between two concentric rotating cylinders, Stoke's first and second problem, Hiemenz flow, flow near a rotating disk, flow in convergent- divergent channels. Slow viscous flow: Stokes and Oseen's approximation,

Module III

Theory of hydrodynamic lubrication. Boundary layer: derivation, exact solutions, Blasius, Falkner Skan, series solution and numerical solutions. Approximate methods. Momentum integral method. Two dimensional and axisymmetric jets. Description of turbulent flow, velocity correlations, Reynold's stresses, Prandtl's Mixing Length Theory, Karman's velocity defect law, universal velocity distribution.

Text Book:

1. Advanced Fluid Mechanics, Som and Biswas, Tata McGraw Hill

Reference Books:

1. Fluid Mechanics, A.K.Mohanty, PHI
2. Fundamentals of Fluid Mechanics, Schlitching
3. Introduction to Fluid Mechanics, Shaughnessy, Oxford University Press
4. Fluid Mechanics:-Frank M .White, TMH
5. Fluid Mechnics:- Cengel and Cimbala, TMH

FLUID POWER & CONTROL

Module – I (12 hrs)

Fluid Power

Introduction, History, Basic Law, types and Advantages of Fluid Power.

Hydraulic fluids and properties: Various types of hydraulic fluids (water, petroleum oil, Water glycols, water oil emulsion, phosphate esters and silicones), properties of Fluids and their comparison.

Basic Principles of Hydraulic Flow: Laminar and Turbulent Flow, Reynolds Number, Darcy-Weisbach Equation, Losses in Valves and Fittings and Circuit Calculations.

Hydraulic Pumps and Actuators:

Pumps: Basic Elements of an Oil Hydraulic System, Hydrodynamic and Hydrostatic Pumps, Classification of Positive Displacement Pumps, Gear Pumps, vane pumps and piston pumps, types, principles and application, Pump performance

Hydraulic Actuators: Hydraulic Motors; Types Hydraulic Motor Efficiencies, Semi-rotary Actuators, Vane Type Actuators, Piston Type Semi-rotary Actuator, Helical Screw Semi-rotary Actuator, different types of Hydraulic Cylinders Mounting Configurations, Methods of applying Linear Motion.

Module – II (12 hrs)

Hydraulic Valves: different types of Pressure Controls, Pressure Relief and Direction Control Valves, Flow dividers and other special purpose valves.

Selection of hydraulic components

Seals and Filters, Conditions Affecting the Selection of Sealing Devices Fluid Contamination Cleanliness Standards

Filtration of Fluids Strainers, Filter Media, Types of Filters, Filter Location Accumulators: Types and their operation, Accumulator Circuits

Servo Valves and Proportional Valves: Types, Principles and applications, comparison between servo and proportional valves.

Pneumatic valves: Types and applications, comparison of hydraulic and Pneumatic valves.

Pneumatic actuators, common pneumatic systems, Selection of pneumatic components.

Hydro – Pneumatic: Air-oil Reservoir: Air-oil Cylinder, Air-oil Intensifier, Comparison of hydro-pneumatic and Pneumatic Systems

Module III (12hrs)

Different hydraulic and pneumatic circuits, Electrical and microelectronic control of fluid power Examples of different industrial hydraulic and pneumatic systems applications, installation, maintenance and trouble shooting, Pneumatic Logic Controls

Text book :

Hydraulic and Pneumatic controls by R. Srinivasan, TMH (2nd Edition)

REFERENCE BOOK:

1. Fluid Power Control by J.F. Blackburn, G. Reethof & J.L. Shearer, John Wiley & Son Inc.

2. Fluid Power with microprocessor control: An Introduction by E.W. Reed and I.S. Larman. Prentice Hall International, N.D.

COMPUTATIONAL FLUID DYNAMICS

Module-I

Basics of Computational Fluid Dynamics (CFD)- Introduction to One dimensional computation: Finite difference methods (FDM)-Finite element method(FEM)-Finite volume method(FVM). Solution of Discretised Equations: The tri-diagonal matrix algorithm (Thomas Algorithm for one dimensional case)

The Finite Volume Method for Diffusion Problems-Introduction -Finite volume method for one-dimensional steady state diffusion -Worked examples: one-dimensional steady state diffusion

Module-II

The Finite Volume Method for Convection-Diffusion Problems – Introduction - Steady one-dimensional convection and diffusion - The central differencing scheme - Assessment of the central differencing scheme for convection-diffusion problems - The upwind differencing scheme - Assessment of the upwind differencing scheme - The hybrid differencing scheme - Assessment of the hybrid differencing scheme - The power-law scheme - Higher order differencing schemes for convection-diffusion problems - Quadratic upwind differencing scheme: the QUICK scheme

Module-III

The Finite Volume Method for Unsteady Flows - Introduction - One-dimensional unsteady heat conduction - Explicit scheme - Crank-Nicolson scheme - The filly implicit scheme - Illustrative examples - Implicit method for two- and three-dimensional problems - Discretisation of transient convection-diffusion equation - Worked example of transient convection-diffusion using QUICK differencing.

Text Book

1. Versteeg, H. K. , Malalasekera W , An Introduction to Computational Fluid Dynamics-The Finite Volume Method, Longman Scientific & Technical.

Reference Books

1. Patenkar V. Subas, Numerical Heat Transfer & Fluid Flow, Taylor & Francis
2. Muralidhar, K. and Sundararajan, T., Computational Fluid Flow and Heat Transfer, Norosa Publishing House, N. Delhi.
3. Ozisik, M. N. , Finite Difference Method, CRC Press.
4. Anderson, D. A. Jr, Computational Fluid Mechanics and Heat Transfer, McGraw-Hill Education.

METROLOGY, QUALITY CONTROL & REALIABILITY

Module I (12 hours)

Principles of Measurements, Line and End & optical Standards, Calibration, accuracy and Precision, Random error and systemic error.

Measurement of Surface Roughness, Screw Thread and Gears.

Limits, Fits and Gauges, Assembly by full, partial and group interchangeability, geometric tolerances.

Measurement of straightness, Flatness and circularity.

Module II (14 hours)

Some useful Probability Distribution, Testing of hypothesis, type I and type II errors, control limit theorem.

Causes of Variation, standard error of mean, process capability, PCR, RPI, Natural tolerance Limits, Specification Limits, Trial and Revised control Limits, Rational subgroups, Control charts for variable (X,R,S, CUSUM, EWMA), Control charts for fraction, non-conforming control charts for non-conformation.

Design of single sampling plan. Double, multiple and sequential sampling plans, O.C. curve, AOQ, AOQL,

Taguchi's Loss function, Orthogonal Arrays, Linear Graphs, parametric design, signal-to noise Ratio, ANOVA, TQM, Taguchi, ISO 9000, ZIT, Quality circle.

Module-III (10 hours)

Definition, bath-tub-curve, system reliability, reliability improvement, maintainability and availability, Availability of single repairable system using Markov model, Life tests, acceptance sampling plan based on life tests, Sequential acceptance sampling plan based on MTTF & MTBF.

Test Books

1. Engineering Metrology,R.K. Jain, Khanna Publisher, Delhi
2. Quality control and Application ,B.L. Hansen and P.M. Ghare, Prentice Hall of India.
3. Reliability Engg. And Terotechnology , A.K. Gupta, Macmillan India.
4. Taguchi methods Explained Practical steps to Robust design T.P. Bagchi, PHI

Reference Books

1. A text book of Engineering Metrology I.C. Gupta, Dhanpat Rai & sons, Delhi.
2. E.L. Grant and R.S. Leveaworth, Statistical quality Control", 7e, mc-Graw Hill.
3. Introduction to Statistical Quality control, D.C. Montgonery, John Wiley & sons.
4. Introduction to /reliability and Maitainability Engg E. Ebeling, MC-Graw Hill.
5. Statistical Quality Control, M. Mahajan, Dhanpat Rai & Sons.
6. Statistical Process Control and Improvement, A. Mitra, Pearson.

SIMULATION MODELLING & CONTROL

Module I **14 hours**

Basic simulation modeling, Discrete event simulation, Simulation of queuing and inventory systems, Continuous, Discrete-continuous and Monte Carlo simulations.

Statistical models in simulation, Discrete and continuous distributions, Poisson process, Empirical distribution, Generation of pseudo random numbers, Analysis of simulation data, Parameter estimation, Goodness-of-fit tests, Multivariable time series models.

Module II **12 hours**

Overview of feedback control systems, Dynamics of mechanical systems, Differential equations and state variable form, Models of electromechanical, Heat-and fluid flow models, Linearization and scaling, Models from experimental data, Dynamic response using pole-zero locations, Time domain specifications, Classical 3-term controllers and its digital implementation, Stability analysis by Routh Criterion.

Modules III **10 hours**

Simulation of manufacturing and material handling systems, Goals and performance measures, Modeling downtime and failures, Trace driven models, Case studies.

Text Books :

1. Discrete-Event system simulation by Jerry Banks, J.S. Carson, B.L. Nelson and D.M. Nicol (Pearson Publications).

2. Feedback control of dynamic systems by G.F. Franklin, J.D. Powell, A-Naeini, Pearson Publications.

3. Simulation modeling and analysis by A.M. Law, W.D. Kelton, Tata McGrawHill Publications.

MECHATRONICS

Module 1 **(10 hours)**

Evolution of Mechatronics, components of mechatronic system, types of mechatronic products, Signal theory, signal analysis and processing, Laplace transformation, Z-transformation modulation and de-modulation.

Electrical components and Electronic device –Resister, inductor and capacitor, reactance and impedance. Basic electronics devices junction diodes, Bipolar transistors

Module II **(10 hours)**

Basic Digital Technology : Digital number system, Binary number system, Hexadecimal number system, Binary addition, Boolean Algebra, Logic function, Universal GATES, FLIP-FLOP, Registers counters.

System modeling : Frequency response, Mechanical system, electrical system, Thermal system, Fluid system.

Module III **(16 hours)**

Actuators- Electric motors; D.C. Motors, Stepper motor, , Hydraulic actuators, Pneumatic actuators

Transducer and Sensors : Principles, difference between transducer and sensors, transducer types – photo emissive, photo conductive, photovoltaic, thermistors, Thermocouple, Inductive, capacitive, Peizoelectric, Hall effect transducers, Ionization transducer, Encoders- Incremental encoder, Optical encoder, Bimetallic strip, Strain gauge, load cell.

Programmable Logic controller : Basic Structure - Programming : Ladder diagram Timers, Internal Relays and Counters - Shift Registers - Master and Jump Controls, data handling , Analog input / output , PLC Selection &Application.

Microprocessor ad Microcontroller : Microprocessor based Digital control, registers, Program counter, Intel -8085 microprocessor

Text Books

1. A Text Books of Mechatronics, R.K.Rajput, S.Chand & company
2. Mechatronics, N.G. P.C Mahalik, Tata McGraw Hill
3. Mechatronics, D.G. Alciator, M.B. Histand, Tata McGraw Hill

Reference Books :

1. Mechatronics, A.Smaili & F Mrad, Oxford University Press
2. Mechatronics, K.P.ramchandran, G,K Vijay Raghavan, M. S Balachandran
3. Mechatronics An Intigrated approach, Clarence W de Sliva, CRC Press

COMPOSITE MATERIALS

Module – I (14 hours)

1. **Introduction :**

Classification and characteristics of composite materials, mechanical behaviour of composites, constituents, Reinforcements, Matrices, Fillers, Additives, Applications and advantages of composites.

2. **Processing :**

Initial form of constituent materials, Manufacturing procedures for fibre-reinforced plastics, quality control.

3. **Macromechanical Behaviour :**

Stress strain relations of anisotropic materials - Engineering constants for orthotropic materials, Stress strain relations for specially orthotropic lamina. Transformation relationships for a lamina of arbitrary fibre orientation.

Module – II (12 hours)

Testing of Composites, Evaluation of Engineering Constants and Strengths.
Micromechanical Analyses of orthotropic lamina, Evaluation of Engineering Constants using Micromechanical principles, Rules of Mixtures, Kelly Davis Model for Minimum and Critical Volume Fractions.

Module – III (10 hours)

FRP Composite Laminate designation and codes, Macromechanical Behaviour of FRP Composite Laminates, Classical Lamination Theory.
General Design Consideration and Suitable laminating Scheme.

Text Book

1. Mechanics of Composite Materials, R.M. Jones, Mc. Graw Hill Book Co.

Reference Book :

1. Fibre - Reinforced composites :- Materials, manufacturing and Design by P.K. Mallick, CRC Press.
2. Engineering Mechanics of Composite Materials, I.M.Danel, O.Issai, Oxord University Press
3. Composite materials, Broutman & Crock,
4. Principles of Composite Material Mechanics, R.F.Gibson, CRC Press

HUMAN RESOURCE MANAGEMENT

Module I:

Concept scope and objectives of HRM. Relationship between HRM and HRD. The challenges for HRM – Environmental, organizational and Individual. Role and functions of HR managers in the changing business scenario.

Human Resources Planning – overview, Recruitment – concept, objectives, legal framework regulating recruitment in India, Selection – Objectives and methods, Test and interviews, Induction and orientation, validity and reliability of Tests and interviews.

Module II:

Career Planning – concept, objectives. Different stages of career and its implications, Methods of career planning and development, Promotion – types and process, Transfer – types. Separations including lay off and retrenchment.

Performance Management – concept and objectives. Performance Appraisal – concept objectives and methods – management by objectives (MBO), Assessment centre, 360 degree feedback. Appraisal errors. Competency mapping – concept, objectives and the process.

Module III:

Compensation Management – objectives and principles. wage & salary. Wage concept – minimum wage, Fair wage, living wage. nominal wage and real wage. Components of wages, methods of wage determination, job evaluation – methods wage differentials and its functions.

Training and Development – Training need Assessment, Types of Training Programs – on the job and off the job training programs, Evaluation of effectiveness of training programs.

Books Recommended

1. Personnel & HRM – P. subha Rao, Himalaya Publishing House.
2. HRM - Text and cases – Aswathappa, THM
3. Managing Human Resources – Gomez, Belkin & Cardy, PHI.
   HRM – Snell, Bohlander, Vohra – Cengage Publication

INDUSTERIAL AUTOMATION & CONTROL

Module I: (12 Hours)
Process Control: Introduction: Process Definition, Feedback Control, PID Control, Multivariable Control. (Chapter 1 of Text Book 1)
PID Controller Tuning: Introduction, Zeigler-Nichols Tuning Method (Based on Ultimate Gain and Period, and Process Reaction Curve), Digital PID Controllers. (Chapter 13 of Text Book 2)

Module II: (15 Hours)
Special Control Structures: Cascade Control, Feedfroward Control, Feedfroward-Feedback Control Configuration, Ratio Control, Selective Control, Adaptive Control, Adaptive Control Configuration. (Chapter 10 and 11 of Text book 3)
Actuators: Introduction, Pneumatic Actuation, Hydraulic Actuation, Electric Actuation, Motor Actuators and Control Valves. (Chapter 8 of Text Book 1)

Module III: (10 Hours)
Industrial Automation: Programmable Logic Controllers: Introduction, Principles of operation, Architecture, Programming (Programming Languages, Ladder Diagram, Boolean Mnemonics) (Chapter 5 of Text Book 1)
Distributed Control: Distributed vs. Centralized, Advantages, Functional Requirements, System Architecture, Distributed Control Systems (DCS), Communication options in DCS. (Chapter 6 of Text Book 1)
Real-time Programming: Multi-tasking, Task Management, Inter-task Communication, Real-time Operating System. (Chapter 9 of Text Book 1)

Text Books:
1. Krishna Kant, “Computer-Based Industrial Control”, PHI, 2009.
2. M. Gopal, “Digital Control and State Variable Methods” Tata McGraw Hill, 2003.
3. Surekha Bhanot, Process Control: Principles and Applications, Oxford university Press, 2010
Reference Books:

1. Smith Carlos and Corripio, “Principles and Practice of Automatic Process Control”, John Wiley & Sons, 2006.
2. Jon Stenerson, “Industrial Automation and Process Control”, Prentice Hall, 2003.
3. C. Johnson, “Process Control Instrumentation Technology”, PHI, New Delhi
4. D.R. Coughnowr, “Process System analysis and Control”, McGraw Hill.

SOFT COMPUTING

MODULE-I (12 Lectures)

Introduction: Soft Computing Constituents and Conventional Artificial Intelligence, Neuro-Fuzzy and Soft Computing Characteristics.

Fuzzy Sets: Introduction, Basic Definitions and Terminology, Set Theoretic Operations, MF Formulation and Parameterization.

Fuzzy Rules & Fuzzy Reasoning: Extension Principle and Fuzzy Relations, Fuzzy If-Then Rules, Fuzzy Reasoning.

Fuzzy Inference Systems: Mamdani Fuzzy Models, Sugeno Fuzzy Models, Tsukamoto Fuzzy Models, Other Considerations.

(BOOK-1:- Chap-1: 1.1 to 1.3, Chap-2: 2.1 to 2.4, Chap-3: 3.2 to 3.4 & Chap-4: 4.2 to 4.5)

MODULE-II (14 Lectures)

Neural Networks: Neuron Abstraction, Neuron Signal Functions, Mathematical Preliminaries, Neural Networks Defined, Architectures: Feed forward and Feedback, Salient Properties and Application Domains of Neural Networks, Multi-layered Network Architectures, Back-propagation Learning Algorithm, Practical Considerations in Implementing the BP Algorithm, Structure Growing Algorithms, Universal Function Approximation and Neural Networks, Applications of Feed Forward Neural Networks, Reinforcement Learning, Radial Basis Function Networks, Regularization Theory Route to RBFNs, Generalized Radial Basis Function Network, Learning in RBFNs, Associative Learning, Hopfield Network, Content Addressable Memory, Bidirectional Associative Memory, Self Organizing Feature Maps, Applications of the Self Organizing Map.

(BOOK-2:-Chap-3: 3.1 to 3.6, Chap-6: 6.1 to 6.2, 6.5 to 6.6 & 6.8 to 6.10, Chap-8: 8.4 to 8.7,

Chap-10: 10.2 & 10.5 to 10.6 & 10.16 and Chap-12: 12.8 to 12.9)

MODULE-III (08 Lectures)

Regression & Optimization: System Identification: an Introduction, Least Squares Estimator, Geometric Interpretation of LSE, Recursive Least Squares Estimator.

Derivative-Free Optimization: Genetic Algorithms, Simulated Annealing, random Search, Downhill Simplex Search.

Adaptive Neuro-Fuzzy Inference Systems (ANFIS): ANFIS Architecture, Hybrid Learning Algorithm.

(BOOK-1:- Chap-5: 5.1, 5.3 to 5.5, Chap-7: 7.2 to 7.5 and Chap-12: 12.2 to 12.3)

TEXT BOOK:

1. "***Neuro-Fuzzy and Soft Computing***" By J.-S.R.Jang, C.-T.Sun & E. Mizutani, PHI

2. "***Neural Networks: A Classroom Approach***" By Satish Kumar, TMH Education

Reference Book:

1. "***Neural Networks Fuzzy Logic & Genetic Algorithms; Synthesis & Applications,*** *S.Rajasekaran & G.A. VijayaLaxmi Pai, Prentice Hall, India, May'2006- LakshmiPai*
2. Principle of Soft Computing, S.N. Sivanandan & S.N. Deepa, Wiley India Edition,2010.

ENTREPRENEURSHIP DEVELOPMENT (3-0-0)

Module I: Understanding Entrepreneurship

Concept of Entrepreneurship, Motivation for Economic Development and Entrepreneurial Achievement, Enterprise and Society

Why and how to start Business – Entrepreneurial traits and skills, Mind Vrs Money in Commencing New Ventures, Entrepreneurial success and failures, Environmental dynamics and change.

Entrepreneurial Process

Step by step approach to entrepreneurial start up

Decision for Entrepreneurial start up.

Module II: Setting up of a small Business Enterprise.

Identifying the Business opportunity - Business opportunities in various sectors, formalities for setting up small enterprises in manufacturing and services, Environmental pollution and allied regulatory and non-regulatory clearances for new venture promotion in SME sector.

Writing a Business plan, components of a B-Plan, determining Bankability of the project.

Module III: Institutional Support for SME.

Central / State level Institution promoting SME.

Financial Management in small business.

Marketing Management, problems & strategies

Problems of HRM – Relevant Labour – laws.

Sickness in Small Enterprises.

Causes and symptoms of sickness – cures of sickness.

Govt. policies on revival of sickness and remedial measures.

Reference Books:

1. Entrepreneurship Development, Small Business Enterprises, Chavantimath, Pearson.
2. Entrepreneurial Development, S.S. Khanka, S Chand
3. Entrepreneurship, Barringer BR, Ireland R.D., Pearson
4. Entrepreneurship, David H Holt, PHI
5. Entrepreneurship, Kurilko, D.F. and Attodgets RM, Cengage
6. The Dynamics of Entrepreneurial Development & Management, Vasant Desai, HPH.
7. Entrepreneurship, Roy, Oxford
8. Entrepreneurship, Hisrich, Peters, Shepherd, TMH

REFRIGERATION & AIR CONDITIONING AND MECHANICAL MEASUREMENT LABORATORY

Refrigeration & Air Conditioning Lab (Minimum 05 experiments)

1. Determination of C.O. P on vapour compression system
2. Determination of C.O. P on vapour absorption system
3. Performance test on Air conditioning test rig (Window type)
4. Performance test on Air conditioning test rig (Duct type)
5. Determination of C.O.P of ice plant
6. Determination of C.O.P of Heat Pump
7. Performance analysis in an experimental cooling tower.

Mechanical Measurement Lab (Minimum 05 experiments**)**

1. Calibration of LVDT using indicator / CRO
2. Calibration of load cell using electrical resistance strain gauge
3. Calibration of a Rotameter for fluid flow measurement
4. Calibration of thermo couples
5. Calibration of Bourden Tube Pressure Gauge and measurement of pressure using manometer
6. Experiment on Pneumatic trainer
7. Experiment on Hydraulic trainer
8. Determination of damping coefficient of vibration absorbing materials using vibration measuring equipment.
9. Strain measurement using resistant strain gauge

Experimental stress analysis through Photo-elasticity.

ENVIRONMENTAL ENGINEERING (3-0-0)

Objective: This course introduces the students to the environmental consequences of Industries, development actions etc. and the methods of minimizing their impact through technology and legal systems.

Module – I

Ecological Concepts and Natural Resources: Ecological perspective and value of environment. Environmental auditing, Biotic components, Ecosystem Process: Energy, Food Chain, Water cycle, Oxygen cycle, Nitrogen cycle etc., Environmental gradients, Tolerance levels of environment factor, EU, US and Indian Environmental Law, Global Perspective.

Chemistry in Environmental Engineering: Atmospheric chemistry, Soil chemistry, Material balances and Reactor configurations.

Module – II

Water Pollution: water quality standards and parameters, Assessment of water quality, Aquatic pollution, Estuarine water quality, Marine pollution, Organic content parameters, Ground water Contamination, Water table and Aquifer, Ground water recharge. Water quality parameter and standards.

Water Treatment: Water treatment processes, Pre-treatment of water, Conventional process, Advanced water treatment process.

Waste Water Treatment: DO and BOD of Waste water treatment process, pretreatment, primary and secondary treatment of waste water, Activated sludge treatment: Anaerobic digestion and its microbiology, Reactor configurations and methane production.

Application of anaerobic digestion.

Air Pollution : Air pollution and pollutants, criteria pollutants, Acid deposition, Global climate change –green house gases, non-criteria pollutants, emission standard form industrial sources, air pollution metereology, Atmospheric dispersion.

Industrial Air Emission Control:

Characterization of air stream, Equipment selection, Equipment design, Special Methods: Flue gas desulphurization, NOx removal, Fugitive emissions.

Module – III

Solid Waste Management Source classification and composition of MSW: properties and separation, storage and transportation, MSW Management, Waste minimization of MSW, Reuse and recycling,

Hazardous Waste Management, Hazardous waste and their generation, Transportation and treatment of hazardous waste: Incinerators, Inorganic waste treatment, handling of treatment plant residue. Waste minimization techniques.

Noise Pollution: Physical Properties of sound, Noise criteria, Noise Standards, Noise measurement, Noise control.

Environment impact Assessment, Origin and procedure of EIA, Project Screening for EIA, Scope studies, Preparation and review of EIS.

Text Book

1. Environmental Engineering Irwin/ McGraw Hill International Edition, 1997, G. Kiely,
2.Environmental Engineering & Safety by Prof B.K. Mohapatra, Seven Seas Publication,Cuttack

Reference Books

1. Environmental Engineering by Arcadio P. Sincero & Gergoria A.Sincero PHI Publication
2. Principles of Environmental Engineering and Science, M. L. Davis and S. J. Masen, McGraw Hill International Edition, 2004
3. Environmental Science, Curringham & Saigo, TMH,
4. Man and Environment by Dash & Mishra
5. An Introduction to Environmental Engineering and Science by Gilbert M. Masters & Wendell P. Ela - PHI Publication.

PRODUCTION & OPERATION MANAGEMENT

Objective : The course aims at acquainting all engineering graduates irrespective of their specializations the basic issues and tools of managing production and operations functions of an organization.

Module I

1. Operations Function in an Organization, Manufacturing Vrs Service Operations, System view of Operations, Strategic Role of Operations, Operations Strategies for Competitive Advantage, Operations Quality and Productivity Focus, Meeting Global Challenges of Production and Operations Imperatives. **(3 Hours)**

2. Designing Products, Services and Processes: New Product Design- Product Life Cycle, Product Development Process, Process Technology : Project, Jobshop, Batch, Assembly Line, Continuous Manufacturing; Process Technology Life Cycle, Process Technology Trends, FMS, CIM, CAD, CAM; Design for Services, Services Process Technology. **(4 Hours)**

3. Work Study: Methods Study- Techniques of Analysis, recording, improvement and standardization; Work Measurement : Work Measurement Principles using Stopwatch Time Study, Predetermined Motion Time Standards and Work Sampling, Standard Time Estimation. **(4 Hours)**

Module II

4. Location and Layout Planning : Factor Influencing Plant and Warehouse Locations, Impact of Location on cost and revenues. Facility Location Procedure and Models : Qualitative Models, Breakeven Analysis, location Model, centroid method.
Layout Planning: Layout Types : Process Layout, Product Layout, Fixed Position Layout Planning, block diagramming, line balancing, computerized layout planning- overview.
Group Technology **(4 Hours)**

5. Forecasting : Principles and Method, Moving Average, weighted Moving Average, Exponential Smoothing, Winter's Method for Seasonal Demand, Forecasting Error.**(4 Hours)**

6. Manufacturing Planning and Control : The Framework and Components : Aggregate Planning, Master Production Scheduling, Rough-cut-Capacity Planning, Material Requirements Planning, Capacity Requirements Planning. **(5 Hours)**

Module III

7. Sequencing and Scheduling : Single Machine Sequencing : Basics and Performance Evaluation Criteria, Methods for Minimizing Mean Flow Time, Parallel Machines : Minimization of Makespan, Flowshop sequencing : 2 and 3 machines cases : Johnson's Rule and Jobshop Scheduling : Priority dispatching Rules. **(3 Hours)**

8. Inventory Control : Relevant Costs, Basic EOQ Model, Model with Quantity discount, Economic Batch Quantity, Periodic and Continuous Review Systems, Safety Stock, Reorder Point and Order Quantity Calculations. ABC Analysis. **(4 Hours)**

9. Modern Trends in Manufacturing : Just in Time (JIT) System : Shop Floor Control By Kanbans, Total Quality Management, Total Productive Maintenance, ISO 9000, Quality Circle, Kaizen, Poka Yoke, Supply Chain Management. **(4 Hours)**

Reference Book:

1. S.N.Chary, "Production and Operations Management", Tata McGraw Hill.
2. R. Paneerselvam, "Production and Operations Management, Prentice Hall of India.
3. Aswathappa & Bhatt – Production & Operations Management, HPH.
4. Gaither & Frazier - Operations Management, Cengage Publication
5. Russell & Taylor - Operations Management, PHI Publication
6. Chase, Aquilanno, Jacob & Agarwal - Operations Management, TMH Publication.
7. E.E. Adam and R.J. Ebert "Production and Operations Management", Prentice Hall of India

POWER PLANT ENGINEERING

Module- I (13Hrs)

INTRODUCTION

Different sources (Conventional and nonconventional) of energy and the principle of power generation only, Types of power plant and site selection, overall view of a steam power plant.

STEAM GENERATOR

Fossil fuel steam generators, classification, circulation in water tube boilers, Modern high pressure water tube boilers(both sub critical and super critical), Boiler mounting and accessories, Combustion equipment: air supply systems (Natural and Mechanical Draught Systems). Pulverized coal burning systems and Basics of Fluidized bed combustion, Feed water treatment (Necessity & general consideration only). Boiler performance calculations.

FLOW THROUGH NOZZLES

Types of nozzles and their area of application & related calculation, critical pressure & chocked flow, super saturated flow. Effect of friction and nozzle efficiency

Module – II **13Hrs**

STEAM TURBINES

Turbine types, Variation of Pressure and Velocity in different types of turbines, Simple impulse Turbines, Flow through turbine blades and velocity diagram, Pressure - compounded impulse turbines and Velocity compounded impulse turbines. Turbine power and related calculations.

REACTION TURBINES

Reaction turbines Flow through blades and velocity diagram, degrees of reaction, Parsons turbine, power and related calculations, Blade height calculations, Losses in steam turbines, Reheat factor & condition line, Governing of turbines.

Module III 14 Hrs

STEAM CONDENSER & CIRCULATING WATER SYSTEMS

Types, Surface condenser, Performance calculation, Air removal methods, Vacuum & vacuum efficiency. Cooling towers.(types, principle of operation and performance)

NUCLEAR POWER PLANT

Introduction, Nuclear fuels, Nuclear fission, Reactor components, & materials and classification,, Boiling Water Reactor (BWR), Pressurized water Reactor (PWR), CANDU Reactor, Gas cooled Reactors, Liquid metal fast breeder Reactor. Heavy water Reactors .Waste disposal and Safety of Nuclear power plant

ECONOMICS OF POWER PLANT

Basic definitions, cost of electrical energy(Fixed cost and operating cost), Types of tariff, Types of loads(typical load curves), Economic Load sharing

Books recommended

1. Power plant Engineering ; - By P.K. Nag (2nd edition) TMH
2. Power Plant Engineering by Arora and Domkundwar, Dhanpat Rai publications

Reference:

1.. Power Plant Engineering by Yadav
2. Power Plant Engineering by Rajput
3. Power plant technology : By E.I. Wakil TMH
4. Power Plant Engineering by C.Elanchezhian, Sarvanakumar, Vijayramnath, IK International Publishing house Pvt Ltd

FATIGUE, CREEP AND FRACTURE

Module – I : (12 hours)

Design philosophy : (i) Infinite life, (ii) Safe life, (iii) Fail safe and (iv) Damage tolerant design concepts.

Fatigue Design : Cyclic stress and stress reversals, Fatigue and progressive fracture, Endurance limit, Fatigue Tests : Cantilever and Beam type of Fatigue Tests, Axial Fatigue Tests. Influence of mean stress on fatigue : Gerber, Goodman and soderberg's criteria. Effect of compressive cyclic stress on fatigue. Fatigue design formula for axial, bending, torsional and combined loading.

Fatigue controlling factors: Effect of frequency, Temperature, size, form, stress concentration factors, Notch, sensitivity & surface conditions, residual stresses.

Module – II : (12 hours)

Improvement of fatigue strength' by chemical/metallurgical processes such as ritriding, flame hardening, case carburizing. Fatigue strength enhancement by mechanical work : cold rolling, peening, shot peening.

Effect of environment : Corrosion Fatigue, Concept of cumulative fatigue damage

Fracture Mechanics : Ductile and brittle fracture Theoretical cohesive strength of metasl, Griffith Theory of brittle Fracture, Oruron's modification to Griffith Theory.

Module – III (14 hours)

Modes of fracture : Mode I, II and III, fatigue creek growth Behaviour of metals, Linear Elastic Fracture Mechanics (LEFM), Stress Intensity Factor(SIF), Stress field near the crack tip, Critical SIF and Fracture Toughness, Experimental determination of fracture toughness K_{IC}, COD gauges and standard ASTM Tests.

Strain Energy Release Rates (SERR), Elasto-Plastic Fracture Mechanics (EPFM), Plastic zone size and its evaluation, J-Integral Method.

Creep Analysis :

Definition, Constant stress and constant, strain creep tests. Uniaxial creep tests : Baily's Power Law, Creep relaxation : strain hardening and time hardening creep relaxation. Introduction to Creep bending and deflection of simple problems.

Text Books:

1. George E. Dieter, Mechanical Metallurgy, - Mc Graw Hill, NY, 1988
2. Joseph Marin, Mechanical Behaviour of Engg. Materials, - Prentice Hall of India, 1966
3. Stephens, R.I. and Fuchs, H.O., Metal Fatigue in Engg. ,- Wiley, NY 2001
4. Finnie, I. and Heller, W.R., Creep of Engg. Materials, - Mc Graw Hill Book Co., 1959
5. Prasant Kumar, Fracture Mechanics

Reference Books:

1. L.S. Srinath, Advanced Mechanics of Materials, - Tata Mc Graw Hill Ltd., ND, 2009.
2. Norman E, Dowling, Mechanical Behaviour of Materials, - Prentice Hall, NJ, 1999.
3. Lessells, J.M., strength and resistance of materials, - John wiley & sons, 1954
4. Peterson, R.E., Stress Concentration Design Factors,- John Wiley & Sons, 1953
5. Meguid, S.A., Fracture Mechanics,- John Wiley & Sons, 1996
6. Kare Hellan, Introduction to Fracture Mechanics, - Mc Graw Hill Book Co., 1985

EXPERIMENTAL STRESS ANALYSIS

Module – I (12 hours)

Elementary Elasticity :

Stress at a point, Principal Stresses in 2D and 3D stress systems, strain and stress-strain velations, principal strains, plane stress and plane strain problems.

Theory of Photo elasticity: Photo elasticity methods- Light and optics as related to photoelasticity, polarization of light, plane and circularly polarized light, plane polariscopes. The stress-optic law, effects of a stressed model in plane and civculor polariscopes. Dark field and light field arrangements.

Module – II (12 hours)

Photoelestic model materials for two-dimensional applications, calibration methods. Analysis techniques, Isochromatic and Isoclinic fringe Patterns, Compensation techniques, stress separation techniques, scaling model to prototype stresses. Birefringent coatings and scattered light in Photo-elasticity, reflection polariscope.

Module – III (14 hours)

Strain-measurement methods and related instrumentation

Electrical resistance strain gauges, Gage construction, gage factor, selection, temperature compensation, semiconductor strain gauges.

Strain gage circuits, Wheatstone and Potentiometer bridge circuits, Rosette Analysis, recording instruments, Dynamic strain measurements.

Brittle coating methods, Behaviour of stress coats and its application.

Grid Technique of displacement/strain analysis.

Text Books:

1. Experimental Stress Analysis by James W. Dally and William F. Riley, Mc Graw Hill Pub. Co., 1965
2. Experimental stress Analysis and Motion Measurements by Dove and Adams Prentice Hall of India (P) Ltd.

References :

1. Timoshenko, S. P. and Goodier, J.N., Theory of Elasticity, Mc Graw Hill Book Co., NY, 1951
2. Durelli, A.J., Phillips, E. and Tsao, C.H., Introduction to the Theoretical and Experimental Analysis of Stress and Strain, Mc Graw Hill Book Co., NY, 1958.
3. Frocht, M.M., Photoelasticity, John Wiley and Sons, Inc., NY, 1948. (vol I & II).
4. Durelli, A.J. Applied stress Analysis, Prentice Hall of India (P) Ltd.

SMART MATERIALS AND STRUCTURES

Module I **14 hours**

1. **Overview** of Smart Materials, Structures and Products Technologies.
2. **Smart Materials (Physical Properties)**
   Piezoelectric Materials, Electrostrictive Materials, Magnetostrictive Materials, Magnetoelectric Materials.
   Magnetorheological Fluids, Electrorheological Fluids, Shape Memory Materials, Fiber-Optic Sensors.
3. **Smart Sensor, Actuator and Transducer Technologies**
   Smart Sensors: Accelerometers; Force Sensors; Load Cells; Torque Sensors; Pressure Sensors;
   Microphones; Impact Hammers; MEMS Sensors; Sensor Arrays
   Smart Actuators: Displacement Actuators; Force Actuators; Power Actuators; Vibration Dampers;
   Shakers; Fluidic Pumps; Motors
   Smart Transducers: Ultrasonic Transducers; Sonic Transducers; Air Transducers

Module II **13 hours**

4. **Measurement, Signal Processing, Drive and Control Techniques**
   Quasi-Static and Dynamic Measurement Methods; Signal-Conditioning Devices; Constant Voltage, Constant Current and Pulse Drive Methods; Calibration Methods; Structural Dynamics and Identification Techniques; Passive, Semi-Active and Active Control; Feedback and Feed forward Control Strategies

Module III **13 hours**

5. **Design, Analysis, Manufacturing and Applications of Engineering Smart Structures and Products**
   Case studies incorporating design, analysis, manufacturing and application issues involved in integrating smart materials and devices with signal processing and control capabilities to engineering smart structures and products. Emphasis on structures, automation and precision manufacturing equipment, automotives, consumer products, sporting products, computer and telecommunications products, as well as medical and dental tools and equipment.

TEXT BOOKS:

1. M. V. Gandhi and B. S. Thompson, Smart Materials and Structures, Chapman & Hall, London; New York, 1992 (ISBN: 0412370107).
2. B. Culshaw, Smart Structures and Materials, Artech House, Boston, 1996 (ISBN:0890066817).

REFERENCE BOOKS

1. A. V. Srinivasan, Smart Structures: Analysis and Design, Cambridge University Press, Cambridge; New York, 2001 (ISBN: 0521650267).
2. H.Thomas.Banks, Ralph Charles Smith, Yun Wang, Smart material structures: modeling, estimation and control, Wiley, 1996, ISBN: 9780471970248
3. Mel M. Schwartz, Smart materials, CRC Press, 2009, ISBN: 9781420043723
4. G. Gautschi, Piezoelectric Sensorics: Force, Strain, Pressure, Acceleration and Acoustic Emission Sensors. Materials and Amplifiers, Springer, Berlin; New York, 2002 (ISBN: 3540422595).
5. K. Uchino, Piezoelectric Actuators and Ultrasonic Motors, Kluwer Academic Publishers, Boston, 1997 (ISBN: 0792398114).
6. K. Otsuka and C. M. Wayman, Shape Memory Materials, Cambridge University Press,. Cambridge; New York, 1998 (ISBN: 052144487X).
7. Andre Preumont, Vibration Control of Active Structures: An Introduction, 2nd Edition, Kluwer Academic Publishers, Dordrecht; Boston, 2002 (ISBN: 1402004966).
8. Peter L. Reece, Smart materials and structures: new research, Nova Publishers, 2007, ISBN: 9781600211072.

MACHINERY FAULT DIAGNOSTICS AND CONDITION MONITORING

Module – I **13 hours**

Principles of Maintenance, Fault analysis planning and system availability: Failure modes, effects and criticality analysis (FMECA), Failure effects assessment (FEA), Critical areas assessment, Fault tree method, Availability concepts, Failure prediction/reliability assessment

Data Processing and Signal Analysis: Computer-Aided Data Acquisition, Time Domain Analysis, Frequency Domain Analysis - Fast Fourier Transform

Performance trend monitoring: Primary monitoring – performance, Primary and secondary performance parameters, Performance trend analysis

Module – II **12 hours**

Vibration Analysis: Vibration monitoring equipment, System monitors and vibration limit detectors, vibration monitoring experience

Discrete frequencies: Introduction, Simple vibrations, Gear excitation, Rolling element bearings, Blade vibration, Fans and Pumps and Case Studies on Vibration Monitoring

Contaminant analysis: Contaminants in used lubricating oils, Carrier fluid degradation, Contaminant monitoring techniques (Wear processes), Oil degradation analysis, Abrasive particles in lubrication oil, Abrasive particle in bearings, Abrasive particle in hydraulic systems, Dissolved gas fault monitoring

Module – III **11 hours**

Electric Motor Current and Signature Analysis

Non-Destructive Test and Evaluation technology: Overview:

Radiography, Ultrasonics: Principle, transducers, equipments and testing

Liquid Penetrant Test, Magnetic Particle Test, Eddy Current Test.

Other Topics: Thermal Infrared Imaging, Acoustic Emission, Leak Testing

Industrial Applications of NDE

Text Books

1. Mechanical Fault Diagnosis and Condition Monitoring by Ralph Albert Collacott, Wiley (or Chapman and Hall, 1977)

Reference Books

1. Condition Based Maintenance and Machine Diagnostics, John W Williams, Alan Davies, Paul R Drake, Springer, 2006
2. Rotating Machinery Vibration; From Analysis to Troubleshooting, Maurice L. Adams, Jr., CRC Press
3. Lubrication and Maintenance of Industrial Machinery; Best Practices and Reliability, R.M.Gresam and G.E.Totten, CRC Press
4. Vibration, Monitoring and Diagnosis: Techniques for Cost-effective Plant Maintenance by Ralph Albert Collacott, 1979, Wiley
5. Handbook on Condition Monitoring, B.K.N. Rao, Elsevier Science 1998
6. Handbook of Condition Monitoring Techniques and Methodology, M.Davies, Springer 2006
7. Vibratory Condition Monitoring of Machines", J.S.Rao, *CRC Press*, 2000
8. Vibration Monitoring, Testing, and Instrumentation, Editor(s)**:** Clarence W. de Silva, *University of British Columbia, Vancouver, Canada*, Series: Mechanical Engineering Series, CRC Press (Taylor & Francis)
9. Non-destructive Test and Evaluation of Materials, J.Prasad and C.G.K.Nair, Tata-McGraw-Hill
10. Machinery Condition Monitoring and Trouble Shooting, John S. Mitchell

MANAGEMENT INFORMATION SYSTEM

MARKETING MANAGEMENT (3-0-0)

Objective of the Course: The course aims at introducing the basic concepts of marketing to the undergraduate students in engineering. The learning shall help the students in better designing, manufacturing and selling product/ service packages keeping competitive market, customers and cost in view.

Module – I (10 hours)

Marketing Management: Concept, Process, Functions and relevance in the current context.

Marketing Environment: Elements of micro and macro environment

Competition Analysis: Factors contributing to competition, porter's five forces model, Identifying and analyzing competitors.

Marketing Planning : Exploring Opportunity, Product –market selection, Marketing Planning Process.

Market Research and Information Systems: Research Process, The Internet and World Wide Web based Information collection and processing, Database, Data Warehouses and Data Mining, Global Market Research.

Consumer Behavior: Factors influencing consumer behavior, consumer decision process. Organizational buying behavior.

Module II (10 hours)

Market Segmentation, Targeting and Positioning: Definition, Bases of segmenting consumer and Industrial markets. Target Market strategies: Market Positioning.

Market Demand Forecasting: Key Terms, Forecasting Tools: Short term tools: Moving average and Exponential smoothing methods, Long-term forecasting Tools: Time series analysis, Econometrics methods, Qualitative tools : Buying Intention Survey, Sales Force Opinion and Delphi Techniques.

Product Planning : Product Life Cycle, New Product Development Process, Branding Strategy, Positioning a Brand, Brand Equity, Packaging and Labeling, Product-mix and Product Line, Planned Obsolescence.

Module – III (10 hours)

Pricing Decision: Objectives and Factors influencing pricing, Pricing method and strategies.

Integrated Marketing Communication(IMC)- Concept of IMC, the marketing communication process, Promotion Mix, elements of promotion mix, Direct marketing.

Channels of Distributions: Types of intermediaries, functions of distribution channels, channel levels, Designing Distribution Channels, Physical Distribution, Supply Chain Management (Basic only).

Trends in Marketing: Green Marketing, Customer Relationship Management, E-marketing, Rural Marketing and Service Marketing (concepts only)

Text Book:

1. Etzel , Walker ,Stanton and Pandit, Marketing, 14/e, Tata McGraw Hill.

2. Saxena, "Marketing Management" Tata McGraw Hill, 4/e.

Reference

1. Grewal, Levy, 'Marketing' Tata McGraw Hill, special Indian edition.

2. Karunakaran "Marketing Management", Himalaya Publishing House, 2010/e.

3. Kotler, Keller,Koshy and Jha, "Marketing Management", 13/e, Pearson Education.

WIRELESS SENSOR NETWORKS

Unit I 8Hrs

Sensor Network Concept: Introduction, Networked wireless sensor devices, Advantages of Sensor networks, Applications, Key design challenges.

Network deployment: Structured versus randomized deployment, Network topology, Connectivity, Connectivity using power control, Coverage metrics, Mobile deployment.

Unit II 8Hrs

Localization and Tracking: Issues and approaches, Problem formulations: Sensing model, collaborative localization. Coarse-grained and Fine-grained node localization. Tracking multiple objects: State space decomposition.

Synchronization: Issues and Traditional approaches, Fine-grained clock synchronization, and Coarse-grained data synchronization.

Unit III 14Hrs

Wireless Communications: Link quality, shadowing and fading effects

Medium-access and sleep scheduling: Traditional MAC protocols, Energy efficiency in MAC protocols, Asynchronous sleep techniques, Sleep-scheduled techniques, and Contention-free protocols.

Routing: Metric-based approaches, Multi-path routing, Lifetime-maximizing energy-aware routing techniques, Geographic routing.

Sensor network Databases: Data-centric routing, Data-gathering with compression, Querying, Data-centric storage and retrieval, the database perspective on sensor networks.

Security: Privacy issues, Attacks and countermeasures.

Text Books:

1. Wireless Sensor Networks: An Information Processing Approach- by Feng Zhao, Leonidas Guibas , Morgan Kaufmann Series in Networking 2004.

References Books:

1. Networking Wireless Sensors: Bhaskar Krismachari, Cambridge University Press
2. Wireless Sensor Networks: Edited by C.S Raghavendra, Krishna M, Sivalingam, Taieb Znati , Springer.
3. Wireless Sensor Networks: Technology, Protocols, and Applications: Kazem Sohraby, Daniel Minoli, Taieb Znati , Wiley Inter Science.

MICRO-ELECTRO-MECHANICAL SYSTEMS (MEMS)

Module-I 14 Lectures
Overview of MEMS and Microsystems. (Chapter 1 of Text Book 1)
Micromachining Techniques: Silicon as material for micromachining, Photolithography, thin film deposition, doping, wet and dry etching, surface and bulk micromachining, Wafer bonding, packaging. (Chapter 3 and Section 8.2 of Text Book 1, Chapter 2 of Text Book 2)

Module II 10 lectures
Microsystem Modeling and Design: Mechanics of deformable bodies, Energy method, Estimation of stiffness and damping for different micro-structures, Modeling of electromechanical systems, Pull-in voltage. (Section 4.1 to 4.3 and 6.2.2 of Text Book 1, Section 3.4 of Text Book 2)

Module III 15 Lectures
MEMS Applications: Mechanical sensors and actuators: Piezoresistive pressure sensors, MEMS capacitive accelerometer, Gyroscopes, Piezoelectric actuators. (Section 8.3 of Text Book 1 and Section 5.3 and 5.11 of Text Book 2)
Optical: Micro-lens, Micro-mirror, Optical switch (Section 7.5 to 7.7 of Text Book 2)
Radio frequency MEMS: Inductor, Varactor, Filter, Resonator. (Section 9.3 to 9.7 of Text Book 2)
Microfluidics: Capillary action, Micropumping, Electrowetting, Lab-on-a-chip. (Section 10.1 to 10.8 of Text Book 2)

Text Books:

1. G.K. Ananthsuresh, K.J. Vinoy, S. Gopalakrishnan, K.N. Bhat and V.K. Atre: Micro and Smart Systems, Wiley India, New Delhi, 2010.
2. N.P. Mahalik: MEMS, Tata McGraw-Hill, New Delhi, 2007.
Reference Book:

1. T. Hsu: MEMS and Microsystems: Design and Manufacture, Tata McGraw-Hill, New Delhi, 2002.