

**DETAIL SYLLABUS**  
**FROM**  
**III - VIII SEMESTER OF B.TECH. DEGREE PROGRAMME**  
*for*  
**ADMISSION BATCH 2015-16**  
**BRANCH-MECHANICAL ENGINEERING**

**TENTATIVE**  
Likely to be Modified

B.Tech (Mechanical Engineering) detail Syllabus for Admission Batch 2015-16 *3rd Semester*

<b>Second Year Engineering</b>								
<b>Third Semester</b>								
	<b>Theory</b>					<b>Practical</b>		
<b>Code</b>	<b>Course Name</b>	<b>Hours/ week L/T</b>	<b>Credit Theory</b>	<b>University Marks</b>	<b>Internal Evaluation</b>	<b>Hours/ Week L/T</b>	<b>Credit Practical</b>	<b>Marks</b>
PC	Mechanics of Solids	3-0	3	100	50	2	1	50
PC	Introduction to Physical Metallurgy & Engg Materials	3-0	3	100	50			
PC	Fluid Mechanics & Hydraulics Machines	3-0	3	100	50	2	1	50
PC	Engg. Thermodynamics	3-0	3	100	50	2	1	50
PC	Kinematics & Dynamics Machines	3-1	4	100	50	2	1	50
HS	Engineering Economics/ Organizational Behavior	2-1	3	100	50			
<b>Total</b>		19	19	600	300	8	4	200
<b>Total Marks: 1100</b>								
<b>Total Credits: 23</b>								
Honours	Applied Mathematics	4	4	100	50			
Minor	Applied Thermal Engineering							

## B.Tech (Mechanical Engineering) detail Syllabus for Admission Batch 2015-16 *3rd Semester*

Semester : 3rd

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1.	PME3D001 Honours (CP)	Applied Mathematics	4-0-0	4
2.	PEK3E001 HS (O1)	Engineering Economics	3-0-0	3
3.	POB3E002 HS (O1)	Organizational Behavior	3-0-0	3
4.	PME3G001 Minor (CP)	Applied Thermal Engineering	4-0-0	4
5.	PME3I001 PC (CP)	Introduction to Physical Metallurgy & Engineering Materials	3-0-0	3
6.	PME3I101 PC (CP)	Mechanics of Solid	3-0-1	4
7.	PME3I102 PC (CP)	Fluid Mechanics & Hydraulics Machines	3-0-1	4
8.	PME3I103 PC (CP)	Engineering Thermodynamics	3-0-1	4
9.	PME3I104 PC (CP)	Kinematics & Dynamics of Machines	4-0-1	5

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TENTATIVE  
Likely to be Modified

**PME3I101 MECHANICS OF SOLID**

*Theory L/T (Hours per week): 3/0, Credit: 3*

**MODULE - I (10 Lectures)**

1. Concept of Stress:

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, Concept of Statically indeterminate problems. Shear stress, Complimentary shear stress, Shear strain, Modulus of rigidity, Poisson's ratio, Bulk Modulus, Relationship between elastic constants.

2. Biaxial State of Stress :

Analysis of Biaxial Stress.Plane stress, Principal plane, Principal stress, Mohr's Circle for Biaxial Stress. Stresses in thin cylinders and thin spherical shells under internal pressure, wire winding of thin cylinders.

**MODULE - II (10 Lectures)**

3. . Biaxial State of Strain:

Two dimensional state of strain, Principal strains, Mohr's circle for strain, Calculation of principal stresses from principal strains, Strain Rossette.

4. Shear Force and Bending Moment Diagrams:

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. Bending of Beams:

Theory of simple bending of initially straight beams, Bending stresses, Shear stresses in bending, Distribution of normal and shear stress, Composite beams.

**MODULE - III (8 Lectures)**

6. Deflection of Beams :

Differential equation of the elastic line, Slope and deflection of beams by integration method and area - moment method.

7. Theory of Columns:

Long columns, Euler's column formula, Lateral buckling, Critical Load, Slenderness ratio, Eccentric loading of short column

**MODULE - IV (8 Lectures)**

8. Torsion:

Torsion in solid and hollow circular shafts, Twisting moment, Strain energy in shear and torsion, strength of solid and hollow circular shafts. Strength of shafts in combined bending and twisting, 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 R.Subramaniam, Oxford University Press

**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
  - a. Student Edition
4. Mechanics of Materials by James M. Gere, Thomson Learning
5. Strength of Materials by James M. Gere and Barry J. Goodno, Cengage Learning
6. Strength of Materials by S.S.Rattan, Tata Mc Graw Hill
7. Engineering Mechanics of Solids by Egor P. Popov, Prentice Hall of India

**MECHANICS OF SOLID LABORATORY**

*Practical L/T/P (Hours per week): 0/0/2, Credit: 3*

**Laboratory Experiments (Minimum 8 experiments)**

1. Determination of tensile strength of materials by Universal Testing Machine
2. Determination of compressive strength of materials by Universal Testing Machine
3. Determination of bending strength of materials by Universal Testing Machine
4. Double shear test in Universal Testing Machine
5. Determination of Impact strength of material (Charpy and Izod)
6. Determination of Hardness strength of materials (Brinell, Rockwell and Vickers)
7. Determination of Rigidity modulus of material
8. Determination of Fatigue strength of material
9. Estimation of Spring Constant under Tension and Compression.
10. Load measurement using Load indicator, Load Cells.
11. Strain measurement using Strain Gauge.
12. Stress measurement using strain rosette.

## **PME3I001 INTRODUCTION TO PHYSICAL METALLURGY AND ENGINEERING MATERIALS**

*Theory L/T (Hours per week): 3/0, Credit: 3*

### **MODULE-I (08 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.

### **MODULE-II (08 Lectures)**

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; recrystallization and grain growth; hot working.

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.

### **MODULE-III (10 Lectures)**

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-IV (10 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. Fibre reinforced plastics, Properties of composites, Metal matrix composites, manufacturing procedure for fiber reinforced composite.

#### **Text Books:**

1. Introduction to Physical Metallurgy by Avner, Tata McGraw Hill
2. Materials Science and Engineering by W.D.Callister, Wiley and Sons Inc.
3. Physical Metallurgy: Principles and Practice by Ragahvan, PHI

**Reference Books**

1. Engineering Physical Metallurgy and Heat Treatment by Y.Lakhtin, Mir Publisher, Moscow.
2. Elements of Material Science and Engineering, L.H.Van Vlack, Addison Wesley
3. Materials Science and Engineering by V.Raghavan, Prentice Hall of India Pvt.Ltd.
4. Elements of Materials Science & Engineering by Van Vlack, Pearson
5. Mechanical Metallurgy by Dieter, Tata MacGraw Hill
6. Composite Material science and Engineering by K. K. Chawla, Springer
7. Material Science and Metallurgy, by U. C. Jindal, Pearson

**PME31102 FLUID MECHANICS AND HYDRAULIC MACHINES**

*Theory L/T (Hours per week): 3/0, Credit: 3*

**Module I (12 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.

**Module II (14 Lectures)**

**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

**Fluid dynamics :** Introduction, Introduction to N-S equation, 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 (8 Lectures)**

**Hydraulic turbines:** 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

**Module IV (06 Lectures)**

**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, Y A Cengel, TMH
2. Fluid Mechanics and Hydraulic Machines, Modi & Seth
3. Fluid Mechanics, A.K. Mohanty, PHI
4. Fluid Mechanics and Machinery, Mohd. Kareem Khan, OXFORD

**Reference Books:**

1. Fluid Mechanics and Machinery, CSP Ojha and P.N. Chandramouli, Oxford University Press
2. Fluid Mechanics and Fluid Machines by A.K.Jain, Khanna Publishers
3. Introduction to Fluid Mechanics and Fluid Machines, S.K. Som and G. Biswas, TMH
4. Introduction to Fluid Mechanics, Fox, McDonald, Willey Publications
5. Fluid Mechanics by Kundu, Elsevier
6. An Introduction to Fluid Dynamics, G.K.Batchelor, Cambridge University Press
7. Engineering Fluid Mechanics by Garde et. al., Scitech
8. First course in Fluid Mechanics by Narasimhan, University press
9. Fluid Mechanics by J.F.Douglas, J.M.Gasiorek, J.A.Swaffield and L.B.Jack, Pearson Education
10. Fluid Mechanics and Machines, Sukumar Pati, TMH

***Practical (Hours per week): 2, Credit: 1***

**Laboratory Exp[eriments (Minimum 8 experiments)**

1. Determination of Metacentric Height and application to stability of floating bodies.
2. Determination of  $C_v$  and  $C_d$  of Orifices.
3. Experiments on impact of Jets
4. Experiments on performance of Pelton Turbine
5. Experiments on performance of Francis Turbine
6. Experiments on performance of Kaplan Turbine
7. Experiments on performance of centrifugal pump
8. Experiments on performance of reciprocating pump
9. Experiments on Reynold's Apparatus
10. 12 Experiments on Flow through pipes
11. Experiments on performance of Gear pump
12. Verifications of momentum equation



**PME31103 ENGINEERING THERMODYNAMICS**

*Theory L/T (Hours per week): 3/0, Credit: 3*

**Module-I (10 Lectures)**

1. Review of First and Second laws:

First law analysis of unsteady flow control volumes, Entropy generation, Entropy balance for closed systems and steady flow systems, Available energy, Quality of energy, Availability for non flow and flow process, Irreversibility, Exergy balance, Second law efficiency.

**Module- II (12 Lectures)**

2. Vapour 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, Cogeneration (Back pressure and Pass-out turbines), Combined-cycle power generation systems, Binary vapour cycles.

3. 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 cycles.

**Module- III (12 Lectures)**

4. Refrigeration cycles:

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

5. General Thermodynamic property relations:

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

**Module- IV (06 Lectures)**

6. 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.

**Text Books**

1. Engineering Thermodynamics by P. K. Nag, Publisher:TMH
2. Engineering Thermodynamics by P. Chattopadhyay, OXFORD
3. Fundamentals of Thermodynamics by Sonntag, Borgnakke, Van Wylen, John Wiley & Sons
4. 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. Thermodynamics and Thermal Engineering by Kothandaraman & Domkundwar, Dhanpat Rai
4. Applied Thermodynamics by P.L.Ballaney, Khanna Publishers
5. Steam Tables in SI Units by Ramalingam, Scitech
6. Steam Tables by C.P.Kothandaraman, New Age International

***Practical (Hours per week): 2, Credit: 1***

### Laboratory Experiments: (Minimum 8 experiments)

1. Study of Cut-Sections of 2 stroke and 4 stroke Diesel Engine.
2. Study of Cut-Sections of 2 stroke and 4 stroke Petrol Engine.
3. Study of steam power plant.
4. Study of refrigeration system.
5. Study of gas turbine power plant.
6. Performance analysis of reciprocating air-compressor.
7. Performance analysis of Centrifugal / Axial Flow compressor.
8. Determination of performance characteristics of gear pump.
9. Measurement of steam quality using calorimeter
10. Verification of Joule-Thomson coefficient.

## **PME3I104 KINEMATICS AND DYNAMICS OF MACHINES**

***Theory L/T (Hours per week): 3/1, Credit: 4***

### Module - I : (10 Lectures)

**1. Kinematic fundamental:** Basic Kinematic concepts and definitions, Degrees of freedom, Elementary Mechanism : Link, joint, Kinematic Pair, Classification of kinematic pairs, Kinematic chain and mechanism, Grüebler's criterion, Inversion of mechanism, Grashof criteria, Four bar linkage and their inversions, Single slider crank mechanism, Double slider crank mechanism and their inversion. Transmission angle and toggle position, Mechanical advantage.

**2. Kinematic Analysis :** Graphical analysis of position, velocity and acceleration of four bar and Slider crank mechanisms. Instantaneous centre method, Aronhold-Kennedy Theorem, Rubbing velocity at a Pin-joint. Coriolis component of acceleration.

**Module - II : (10 Lectures)**

**3. Mechanism Synthesis** :Graphical methods of synthesis, Chebychev spacing for precision positions, Freudenstein's equation applicable to four bar linkages.

**4. Mechanism Trains:** Gear Terminology and definitions, Analysis of mechanism Trains: Simple Train, Compound train, Reverted train, Epicyclic train and their applications.

**Module - III : (8 Lectures)**

**5. Combined Static and Inertia Force Analysis:** Inertia forces analysis, velocity and acceleration of slider crank mechanism by analytical method, engine force analysis - piston effort, force acting along the connecting rod, crank effort. dynamically equivalent system, compound pendulum, correction couple.

**6. Friction Effects:** Screw jack, friction between pivot and collars, single, multi-plate and cone clutches, anti friction bearing, film friction, friction circle, friction axis,

**Module - IV : (8 Lectures)**

**7. Flexible Mechanical Elements:** Belt, rope and chain drives, initial tension, effect of centrifugal tension on power transmission, maximum power transmission capacity, belt creep and slip.

**8. 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 dynamometer, belt transmission, epicyclic train, torsion dynamometer.

**Text Books**

1. Kinematics and Dynamics of Machinery by R L Norton, Tata MacGraw Hill
2. Theory of Machines and Mechanisms by John J. Uicker Jr., Gordon R. Pennock and Joseph E. Shigley, Oxford University Press
3. Theory of Machines by S.S.Rattan, Tata MacGraw Hill

**Reference**

1. Theory of Machines by Thomas Bevan, CBS Publications
2. Kinematics and Dynamics of Machinery by Charles E. Wilson and J.Peter Saddler, Pearson Education
3. Mechanism and Machine Theory by J.S.Rao and R.V.Dukupatti, New Age International.
4. Theory of Mechanisms and Machines by A. Ghosh & A. K. Mallick, East West Press.
5. Kinematics and Dynamics of Machines by G.H. Martin, McGraw-Hill.
6. Theory of Machines and Mechanisms by P.L.Ballaney, Khanna Publishers
7. Theory of Mechanisms and Machines by C.S.Sharma and K.Purohit, PHI.

***Practical (Hours per week): 2, Credit: 1***

**Laboratory Experiments: (Minimum 8 experiments)**

1. Design of any one working model related to Kinematics of Mechanisms i.e., Module I and II.
2. Design of any one working model related to Dynamics of Machinery i.e., Module III and IV.
3. Radius of gyration of compound pendulum
4. Radius of gyration of connecting rod
5. TRI –FILAR / BI-FILAR System
6. Experiment on Screw Jack
7. Experiment on Journal Bearing Apparatus
8. Experiment/Study on clutches
9. Experiment on Epicyclic Gear Train
10. Experiments on Simple/Compound/Reverted Gear trains
11. Experiment on Dynamometer
12. Experiment on Brake
13. Experiment on Coriolis component of acceleration

**PEK3E001 ENGINEERING ECONOMICS**

***Theory L/T (Hours per week):2/1, Credit: 3***

**Module I (12 hours)**

Engineering Economics- Nature, Scope, Basic problems of an economy, Micro Economics and Macro Economics.

Demand- Meaning of demand, Demand function, Law of Demand and its exceptions, Determinants of demand, Elasticity of demand & its measurement (Simple numerical problems to be solved ), Supply-Meaning of supply, Law of supply and its exception, Determinants of supply, Elasticity of supply, Determination of market equilibrium (Simple numerical problems to be solved).

Production-Production function, Laws of returns: Law of variable proportion, Law of returns to scale

**Module II (12 hours)**

Cost and revenue concepts, Basic understanding of different market structures, Determination of equilibrium price under perfect competition (Simple numerical problems to be solved), Break Even Analysis-linear approach (Simple numerical problems to be solved).

Banking -Commercial bank, Functions of commercial bank, Central bank, Functions of Central Bank.

Inflation-Meaning of inflation, types, causes, measures to control inflation.

National Income-Definition, Concepts of national income, Method of measuring national income.

**Module III (12 hours)**

Time value of money- Interest - Simple and compound, nominal and effective rate of interest, Cash flow diagrams, Principles of economic equivalence.

Evaluation of engineering projects-Present worth method, Future worth method, Annual worth method, Internal rate of return method, Cost benefit analysis for public projects .

Depreciation- Depreciation of capital asset, Causes of depreciation, Methods of calculating depreciation (Straight line method, Declining balance method), After tax comparison of project.

**Text Books**

1. Riggs, Bedworth and Randhwa, "Engineering Economics", McGraw Hill Education India
2. Principles of Economics, Deviga Vengedasalam; Karunagaran Madhavan, Oxford University Press.
3. Engineering Economy by William G.Sullivan, Elin M.Wicks, C. Patric Koelling, Pearson
4. R.Paneer Seelvan, " Engineering Economics", PHI
5. Ahuja,H.L., "Principles of Micro Economics" , S.Chand & Company Ltd
6. Jhingan,M.L., "Macro Economic Theory"
7. Macro Economics by S.P.Gupta, TMH

**POB3E002 ORGANIZATIONAL BEHAVIOUR**

**Credit- 3      Class Hours - 40**

**Objectives:**

1. To develop an understanding of the behavior of individuals and groups inside organizations
2. To enhance skills in understanding and appreciating individuals, interpersonal, and group process for increased effectiveness both within and outside of organizations.
3. To develop theoretical and practical insights and problem-solving capabilities for effectively managing the organizational processes.

<b>Unit</b>	<b>Contents</b>	<b>Class Hours</b>
<b>01</b>	<b>Fundamentals of OB:</b> Definition, scope and importance of OB, Relationship between OB and the individual, Evolution of OB, Theoretical framework (cognitive), behavioristic and social cognitive), Limitations of OB.	<b>6</b>
<b>02</b>	<b>Attitude:</b> Importance of attitude in an organization, Right Attitude, Components of attitude, Relationship between behavior and attitude, Developing Emotional intelligence at the workplace, Job attitude, Barriers to changing attitudes. <b>Personality and values:</b> Definition and importance of Personality for performance, The Myers-Briggs Type Indicator and The Big Five personality	<b>10</b>

model, Significant personality traits suitable to the workplace (personality and job – fit theory), Personality Tests and their practical applications.

**Perception:** Meaning and concept of perception, Factors influencing perception, Selective perception, Attribution theory, Perceptual process, Social perception (stereotyping and halo effect).

**Motivation:** Definition & Concept of Motive & Motivation, The Content Theories of Motivation (Maslow's Need Hierarchy & Herzberg's Two Factor model Theory), The Process Theories (Vroom's expectancy Theory & Porter Lawler model), Contemporary Theories – Equity Theory of Work Motivation.

**03 Foundations of Group Behavior:** The Meaning of Group & Group behavior & Group Dynamics, Types of Groups, The Five – Stage Model of Group Development. **9**

**Managing Teams:** Why Work Teams, Work Teams in Organization, Developing Work Teams, Team Effectiveness & Team Building.

**Leadership:** Concept of Leadership, Styles of Leadership, Trait Approach Contingency Leadership Approach, Contemporary leadership, Meaning and significance of contemporary leadership, Concept of transformations leadership, Contemporary theories of leadership, Success stories of today's Global and Indian leaders.

**04 Organizational Culture :** Meaning & Definition of Organizational Culture, creating & Sustaining Organizational Culture, Types of Culture (Strong vs. Weak Culture, Soft Vs. Hard Culture & Formal vs. Informal Culture), Creating Positive Organizational Culture, Concept of Workplace Spirituality. **8**

**05 Organizational Change:** Meaning, Definition & Nature of Organizational Change, Types of Organizational Change, Forces that acts as stimulants to change. **7**  
Implementing Organizational Change : How to overcome the Resistance to Change, Approaches to managing Organizational Change, Kurt Lewin's-Three step model, Seven Stage model of Change & Kotter's Eight-Step plan for Implementing Change, Leading the Change Process, Facilitating Change, Dealing with Individual & Group Resistance, Intervention Strategies for Facilitating Organizational Change, Methods of Implementing Organizational Change, Developing a Learning Organization.

#### Reference Books

1. Understanding Organizational Behaviour, Parek, Oxford
2. Organizational Behaviour, Robbins, Judge, Sanghi, Pearson.
3. Organizational Behaviour, K. Awathappa, HPH.
4. Organizational Behaviour, VSP Rao, Excel
5. Introduction to Organizational Behaviour, Moorhead, Griffin, Cengage.
6. Organizational Behaviour, Hitt, Miller, Colella, Wiley

## **HONOURS ELECTIVE**

### **PME3D001 APPLIED MATHEMATICS (L/T: 4/0, Credit: 4)**

#### **Module-I (15 Hours)**

##### **Probability:**

Probability, Random variables, Probability distributions, Mean and variance of distribution, Binomial, Poisson, and Hyper-geometric distributions, Normal and exponential distribution, Distribution of several random variables.

##### **Statistics:**

Random sampling, Estimation of Parameters, Confidence Intervals, Testing of hypothesis, Acceptance sampling, Regression Analysis, Fitting Straight Lines, Correlation analysis

#### **Module-II (15 Hours)**

##### **Partial Differential Equation:**

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.

#### **Module-III (08 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-IV (06 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
2. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw Hill

##### **Reference books:**

1. E.B. Saff, A.D. Snider, "Fundamental of Complex Analysis", Third Edition, Pearson
2. Jay L. Devore, "Probability and Statistics for Engineering and Sciences", Seventh Edition, Thomson/CENGAGE Learning India Pvt. Ltd
3. P. V.O'Neil, "Advanced Engineering Mathematics", CENGAGE Learning, New Delhi
4. Mathematical Methods by Potter Goldberg Publisher: PHI

## **MINOR SPECIALIZATION**

### **PME3G001 APPLIED THERMAL ENGINEERING**

*Theory L/T (Hours per week): 4/0, Credit: 4*

#### **Module-I ( 8 Lectures)**

Review of First and Second laws:

First law analysis of unsteady flow control volumes, Entropy change for different process, Entropy generation, Entropy balance for closed systems and steady flow systems, Available energy, Quality of energy, Availability for non flow and flow process, Irreversibility, Second law efficiency.

#### **Module - II (8 Lectures)**

**Air Standard Cycle & Introduction to I.C. Engine:** Otto, diesel and dual cycles, description and operation of four and two stroke cycle engine, comparison of SI and CI engines, valve timing diagram, power output and efficiency calculation. Brayton cycle, Gas turbine, Jet engines.

**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 - III (12 Lectures)**

**Steam and Steam Generator:-** Properties of steam, measurement of dryness fraction, use of steam table and Mollier chart. T-S and H-S diagrams for representing thermodynamic processes. Boiler, Classification of boiler, comparison between water tube boiler and fire tube boiler. Boiler mountings and accessories. Description of Cochran & Babcock -Wilcox boiler.

**Steam Nozzles:-** Types of nozzles, isentropic flow through nozzles, effect of friction on nozzle efficiency. Critical pressure ratio and maximum discharge, throat and exit area.

#### **Module - IV (14 Lectures)**

**Steam Turbines & Condensers:-** Turbine type and applications. Impulse turbine, pressure and velocity compounding, velocity diagram, work output, losses and efficiency. Impulse reaction turbine, velocity diagram, degree of reaction, work output, losses and efficiency. Jet and surface condensers. Condenser vacuum and vacuum efficiency.

**Heat Transfer:** Basic modes of heat transfer, one dimensional steady state, conduction through slab, cylinder and sphere ; basic theory of radiant heat transfer, black body & mono chromatic radiation, total emissive power, heat exchangers.

**Refrigeration system:** Reversed Carnot cycle, Reversed Brayton cycle (Gas refrigeration system), The vapor compression cycle, The vapor absorption cycle, air conditioning.

#### **Text Books**

1. Engineering Thermodynamics by P. Chattopadhyay, OXFORD
2. Power plant Engineering by P. K. Nag, Publisher:TMH
3. Applied Thermodynamics by P.L.Ballaney, Khanna Publishers.



**Reference**

1. Fundamentals of Thermodynamics by Sonntag, Borgnakke, Van Wylen, John Wiley & Sons
2. Fundamentals of Engineering Thermodynamics by E. Rathakrishnan, PHI
3. Engineering Thermodynamics by M. Achyuthan, PHI
4. Engineering Thermodynamics by Y.V.C. Rao, University Press
5. Thermodynamics and Thermal Engineering by Kothandaraman & Domkundwar, Dhanpat Rai
6. Steam Tables in SI Units by Ramalingam, Scitech
7. Steam Tables by C.P.Kothandaraman, New Age International

TENTATIVE  
Likely to be Modified

B.Tech (Mechanical Engineering) detail Syllabus for Admission Batch 2015-16 *4th Semester*

Fourth Semester								
		Theory				Practical		
Code	Course Name	Hours/ week L/T	Credit Theory	University Marks	Internal Evaluation	Hours/ Week L/T	Credit Practical	Marks
HS	Applied Mathematics - III	3-0	3	100	50			
PC	Mechanisms & Machines	3-0	3	100	50	2	1	50
PC	Basic Manufacturing Process	3-0	3	100	50	2	1	50
PC	IC Engine & Gas Turbine	3-0	3	100	50	2	1	50
PC	Mechanical Measurement, Metallurgy & Reliability	3-0	3	100	50	2	1	50
HS	Engineering Economics/ Organizational Behavior	2-1	3	100	50			
	*Skill Project and Hands on					6	3	100
Total		18	18	600	300	14	7	300
Total Marks: 1200								
Total Credits: 25								
Honours	Statistical Quality Control/Surface Engineering/Rapid Manufacturing Process	4	4	100	50			
Minor	Fluid Mechanics & Hydraulics Machines							

## B.Tech (Mechanical Engineering) detail Syllabus for Admission Batch 2015-16 *4th Semester*

SEMESTER : 4TH

1.	PME4D001	HONOURS (O2)	STATISTICAL QUALITY CONTROL	4-0-0	4
2.	PME4D002	HONOURS (O2)	SURFACE ENGINEERING	4-0-0	4
3.	PME4D003	HONOURS (O2)	RAPID MANUFACTURING PROCESS	4-0-0	4
4.	PME4E001	HS (CP)	PURELY APPLIED MATHEMATICS FOR SPECIFIC BRANCH OF ENGINEERING	3-0-0	3
5.	PEK4E002	HS (O1)	ENGINEERING ECONOMICS	3-0-0	3
6.	POB4E003	HS (O1)	ORGANIZATIONAL BEHAVIOR	3-0-0	3
7.	PME4G001	MINOR (CP)	FLUID MECHANICS & HYDRAULICS MACHINES	4-0-0	4
8.	PME4I101	PC (CP)	MECHANISM & MACHINES	3-0-1	4
9.	PME4I102	PC (CP)	BASIC MANUFACTURING PROCESS	3-0-1	4
10.	PME4I103	PC (CP)	IC ENGINE & GAS TURBINE	3-0-1	4
11.	PME4I104	PC (CP)	MECHANICAL MEASUREMENT, METALLURGY & RELIABILITY	3-0-1	4
12.	PME4I201	PC (CP)	SKILL PROJECT AND HANDS ON	0-0-3	3

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TENTATIVE  
Likely to be Modified

## PME4I101 MECHANISMS AND MACHINES

### MODULE - I (8 HOURS)

**1. Mechanisms with lower pairs :** Motor Vehicle Steering Gears - Davis Steering Gear & Ackermann Steering Gear, Hooke's Joint.

**2. Cams Design:** Fundamental law of Cam, Cam Terminology, Classification of Cams and followers, Analysis of follower motions (Displacement, velocity, Acceleration and jerk) – Simple Harmonic, Uniform Velocity and Constant Acceleration & Retardation Types, Generation of Cam Profiles by Graphical Method, Introduction on Cams with specified contours.

### MODULE - II (8 HOURS)

**3. Turning Moment Diagram and Flywheel:** Turning moment diagram. Turning moment diagrams for different types of engines, Fluctuation of energy and fluctuation of speed. Dynamic Theory of Flywheel, Flywheel of an internal combustion engine and for a punch machine. Determination of flywheel size from Turning Moment Diagram.

**4. Gears :** Theory of shape and action of tooth properties and methods of generation of standard tooth profiles, Standard proportions, Force analysis, Path of contact, Arc of contact, Contact ratio, Interference and Undercutting, Methods for eliminating Interference, Minimum number of teeth to avoid interference.

### MODULE III (8 HOURS)

**5. Mechanism for Control (Governors):** Governors - Watt, Porter, Proell, Hartnell, Wilson-Hartnell Governor. Performance parameters: Sensitiveness, Stability, Hunting, Isochronism. Governor Effort and Power, Controlling Force & Controlling Force Curve, Friction & insensitiveness, Comparison between governor and flywheel.

**6. Mechanism for Control (Gyroscope):** Introduction to Gyroscopes. Gyroscopic forces and Couple. Effect of Gyroscopic Couple on Aeroplanes, Gyroscopic stabilization of ship, Stability of Two Wheelers and Four Wheelers. Rigid disc at an angle fixed to rotating shaft.

### MODULE IV (8 HOURS)

**7. Balancing of rotating components and linkages:** 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. Balancing of locomotive: variation of tractive force, swaying couple, hammer blow. Direct and Reverse Crank method of balancing for radial engines. Balancing of V-engine. Balancing machines: Pivoted-Cradle Balancing Machine.

**8. Vibrations:** Introduction to Mechanical Vibration – Definitions, elements of vibratory system, Longitudinal, Torsional & Transverse Systems. Differential equations and solutions of motion for a coupled spring mass system. Determination of natural frequency of vibratory systems using energy method, equilibrium method and Rayleigh's method, Free and Forced Vibration of Un-damped and Damped Single Degree Freedom Systems, Logarithmic decrement, Magnification factor, Vibration isolation and transmissibility, whirling of shafts and Evaluation of Critical Speeds of shafts.

### TEXT BOOKS

1. Theory of Machines by S.S.Rattan, Tata MacGraw Hill
2. Theory of Machines and Mechanisms (India Edition) by John J. Uicker Jr., Gordon R. Pennock and Joseph E. Shigley, Oxford University Press
3. Mechanism and Machine Theory by J.S.Rao and R.V.Dukipatti, New Age International.
4. Theory of Mechanisms and Machines by A. Ghosh & A. K. Mallick, East West Press.

**REFERENCE**

1. Theory of Machines by Thomas Bevan, CBS Publications.
2. Kinematics and Dynamics of Machinery by R.L.Norton, Tata MacGraw Hill
3. Kinematics & Dynamics of Machinery-Charles E. Wilson & J.Peter Saddler, Pearson Ed.
4. Theory of Mechanisms and Machines by C.S.Sharma and K.Purohit, PHI
5. Theory of Machines by Shah Jadwani, Dhanpat Rai
6. Theory of Machines by Abdulla Shariff, Dhanpat Rai
8. Theory of Machines by Sadhu Singh, Pearson Education.

**PRACTICAL**

**Practical (0-0-2) Credit: 1**

1 and 2 are compulsory. In addition, minimum six experiments from sl. No. 3-10 to be performed.

1. Design of any one working model related to Mechanisms and Machines i.e., Module I and II.
2. Design of any one working model related to Mechanisms and Machines i.e., Module III and IV.
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 evaluation of damping in a vibrating system

## **PME4I102 BASIC MANUFACTURING PROCESS**

### **MODULE - I (10 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<sub>2</sub> 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 (8 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. Weldability 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.

### **MODULE - III (08 LECTURES)**

3. Brief introduction to powder metallurgy processes.
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.

### **MODULE - IV (08 LECTURES)**

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

## **PRACTICAL (BASIC MANUFACTURING PROCESS LABORATORY)**

### **LIST OF EXPERIMENTS:**

1. Determination of grain size, clay content, permeability and green compressive strength of Molding sand. (2 to 3 experiments)
2. Foundry Practices
3. Preparation of a wood pattern.
4. Determination of strength of brazed and solder joints
5. Practice and preparation of job in TIG/MIG welding
6. Practice and preparation of job in sheet metal using processes like forming and deep drawing.
7. Demonstration of different rolling mills
8. Demonstration of Extrusion processes

## **PME4I103 INTERNAL COMBUSTION ENGINES AND GAS TURBINES**

### **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.

#### **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 (12 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 (8 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.

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

**Engine Emission and control :**

Mechanism of pollutant formation and its harmful effects. Methods of measuring pollutants and control of engine emission.

**Module-IV (9 hours)**

**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. IC Engines, Mathur & Sharma
2. Internal Combustion Engines, V. Ganesan, TMH, 3<sup>rd</sup> edition
3. Gas Turbines, V. Ganesan, TMH, 3<sup>rd</sup> edition

**Reference books:**

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

**PRACTICAL (I. C. ENGINE LABORATORY)**

1. Valve timing diagram of an IC engine
2. Study of a modern carburetor (e.g. Solex Carburetor)
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.
7. Load test on 4-stroke single cylinder C.I. engine.
8. Load test on 4-stroke single cylinder S.I. engine.
9. Morse Test on multi-cylinder S.I. or C.I. engine
10. Load test on variable compression ratio S.I. engine
11. Load test and Heat balance on 2 stroke S.I. Engine



## **PME4I104 MECHANICAL MEASUREMENT, METROLOGY & RELIABILITY**

### **MODULE - I (16 HOURS)**

Definition and methods of measurement, classification of measuring instruments, Measuring systems, performance characteristics of measuring devices, types of errors. Functional elements of measuring system. 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 Contact 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, Differential and Integrating Elements, Filters, A-D and D-A Converters

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 starting 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 - II (10 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 - 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.

**TEXT BOOKS :**

1. Engineering Metrology & Measurement, N.V.Raghavendra and L. Krishnamurthy, OXFORD University Press
2. Instrumentation Measurement and Analysis, B.C.Nakra and KK.Chaudhry, Tata Mc Graw Hill, Third Edition.
3. Engineering Metrology, R.K. Jain, Khanna Publisher, Delhi
4. Reliability Engg. And Terotechnology, A.K. Gupta, Macmillan India.

**Reference Books:**

1. Metrology & Measurement, A. K. Bewoor and V.A.Kulkarni, Mc Graw hill
2. Mechanical Measurements, T.G. Beckwith and N. Lewis Buck, Oxford and IBH Publishing Co.
3. A text book of Engineering Metrology I.C. Gupta, Dhanpat Rai & sons, Delhi.
4. Introduction to /reliability and Maitainability Engg E. Ebeling, MC-Graw Hill.

**PRACTICAL**

**(MECHANICAL MEASUREMENT, METROLOGY & RELIABILITY LAB)**

(Minimum 08 Experiments/Studies)

List of 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
10. Measurement of straightness and flatness
11. Measurement of roughness of the surface
12. Experiment on slip gauges and sine bar

## **PME4D002 SURFACE ENGINEERING (HONORS ELECTIVE)**

### **MODULE - I (14 HOURS)**

Mechanisms of Wear and Metal Cleaning: Basic Mechanisms of wear-abrasive, adhesive wear, contact fatigue, Fretting corrosion, Testing of wear resistance, practical diagnosis of wear, general cleaning process for ferrous and non ferrous metals and alloys selection of cleaning processes, alkaline cleaning, emulsion cleaning, ultrasonic cleaning, pickling salt bath descaling, abrasive bath cleaning, polishing and buffing shot peening.

### **MODULE - II (16 HOURS)**

Thermal Spraying Processes and Electrodeposited Coatings: Thermal spraying materials, characteristics of thermal spray processes, Design for thermally sprayed coatings coating production, spray fused coatings, Principles of electroplating, Technology and control-electroplating systems, Properties and applications of electrodeposits, Non aqueous and electroless deposition, plasma coating.

Hot Dip Coating and Diffusion Coating: Principles, Surface preparation, Batchcoating and continuous coating process, Coating properties and application, Principles of cementation, Cladding-vacuum deposition, Sprayed metal coating, Structure of diffusion coatings, Chemical vapour deposition (CVD), Physical vapour deposition (PVD).

### **MODULE - III (14 HOURS)**

Non-Metallic Coating Oxide and Conversion Coatings: Plating coating, lacquers, rubbers and elastomers, vitreous enamels, anodizing Chromating, application to aluminium, magnesium, tin, zinc, cadmium copper and silver, phosphating primers.

Quality Assurance, Testing and Selection of Coatings: The quality plan, design, testing and inspection, thickness and porosity measurement, selection of coatings, industrial applications of engineering coatings.

### **TEXT BOOKS :**

1. Engineering Coatings-design and application- S. Grainger, Jaico Publishing House.
2. Principles of Metals surface treatment and protection- D. R. Gabe, Pergamon.

### **REFERENCE BOOKS:**

1. Electroplating Handbooks- N.V.Parathasarathy, Prentice Hall.
2. Advances in surface treatment- Niku-Lavi, Pergamon.

## **PME4D003 RAPID MANUFACTURING PROCESS (HONORS ELECTIVE)**

### **MODULE - I (14 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 (14 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, Ballistic particle manufacturing – both 2D and 3D, Fused deposition modeling, Shape melting

### **MODULE - III (16 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 BOOKS :**

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, Gurusurthi, 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

**PME4G001 FLUID MECHANICS AND HYDRAULIC MACHINES**  
**(Minor Specialization)**

**MODULE I (12 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.

**MODULE II (12 LECTURES)**

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

Fluid dynamics : Introduction, Introduction to N-S equation, 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 (10 LECTURES)**

Hydraulic turbines: 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

**MODULE IV (06 LECTURES)**

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, A.K.Jain, Khanna Publishers
2. Fluid Mechanics and Hydraulic Machines, Modi & Seth
3. Introduction to Fluid Mechanics and Fluid Machines, S.K. Som and G. Biswas, TMH
4. Fluid Mechanics and Machinery, Mohd. Kareem Khan, OXFORD

**Reference Books:**

1. Fluid Mechanics, A.K. Mohanty, PHI
2. Introduction to Fluid Mechanics, Fox, McDonald, Willey Publications
3. Fluid Mechanics by Kundu, Elsevier
4. An Introduction to Fluid Dynamics, 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
8. Fluid Mechanics and Machines, Sukumar Pati, TMH

TENTATIVE  
Likely to be Modified

B.Tech (Mechanical Engineering) detail Syllabus for Admission Batch 2015-16 *5th Semester*

Fifth Semester								
Code	Course Name	Theory				Practical		
		Hours/ week L/T	Credit Theory	University Marks	Internal Evaluation	Hours/ week L/T	Credit Practical	Marks
PC	Design of Machine Elements	3-0	3	100	50	2	1	50
PC	Machining Science & Technology	3-0	3	100	50	2	1	50
PC	Heat Transfer	3-0	3	100	50	2	1	50
PE	Optimization in Engg./Project Management/Quality Management & Reliability	3-1	4	100	50			
OE	Energy Conversion Techniques/Human Resources Management/Marketing Management/C++ & Object Oriented Programming/Internet & Web Technology/Analog & Digital Electronics/Digital Signal Processing	3-1	4	100	50			
PC	Advance Lab-I					8	4	200
<b>Total</b>		<b>17</b>	<b>17</b>	<b>500</b>	<b>250</b>	<b>14</b>	<b>7</b>	<b>350</b>
<b>Total Marks: 1100</b>								
<b>Total Credits: 24</b>								
Honours	Advanced Mechanics of Solids / Design of Machine Components/ Experimental Stress Analysis	4	4	100	50			
Minor	Manufacturing Process							

B.Tech (Mechanical Engineering) detail Syllabus for Admission Batch 2015-16 *5th Semester*

SEMESTER : 5TH

1.	PME5D001	HONOURS (O4)	ADVANCED MECHANICS OF SOLIDS	4-0-0	4
2.	PME5D002	HONOURS (O4)	DESIGN OF MACHINE COMPONENTS	4-0-0	4
3.	PME5D003	HONOURS (O4)	EXPERIMENTAL STRESS ANALYSIS	4-0-0	4
4.	PME5G001	MINOR (CP)	MANUFACTURING PROCESS	4-0-0	4
5.	PME5H001	OE (O2)	ENERGY CONVERSION TECHNIQUES	4-0-0	4
6.	PME5H002	OE (O2)	HUMAN RESOURCES MANAGEMENT	4-0-0	4
7.	PME5H003	OE (O2)	MARKETING MANAGEMENT	4-0-0	4
8.	PME5H004	OE (O2)	C++ & OBJECT ORIENTED PROGRAMMING	4-0-0	4
9.	PME5H005	OE (O2)	INTERNET & WEB TECHNOLOGY	4-0-0	4
10.	PME5H006	OE (O2)	ANALOG & DIGITAL ELECTRONICS	4-0-0	4
11.	PME5H007	OE (O2)	DIGITAL SIGNAL PROCESSING	4-0-0	4
12.	PME5I001	PC (CP)	DESIGN OF MACHINE ELEMENTS	3-0-0	3
13.	PME5I101	PC (CP)	MACHINING SCIENCE & TECHNOLOGY	3-0-1	4
14.	PME5I102	PC (CP)	HEAT TRANSFER	3-0-1	4
15.	PME5I201	PC (CP)	ADVANCE LAB - I	0-0-4	4
16.	PME5J101	PE (O3)	OPTIMIZATION IN ENGINEERING	4-0-1	4
17.	PME5J102	PE (O3)	PROJECT MANAGEMENT	4-0-1	4
18.	PME5J103	PE (O3)	QUALITY MANAGEMENT & RELIABILITY	4-0-1	4

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**PME5I001 DESIGN OF MACHINE ELEMENTS**

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

**MODULE-I (8 HOURS)**

**1. Mechanical engineering design:** Introduction to design procedure, Stages in design, Code and Standardization, Interchangeability, Preferred numbers, Fits and Tolerances, Engineering materials: Ferrous, Non-ferrous, Non-metals, design requirements – properties of materials, Material selection, Use of Data books.

**2. Fundamentals of Machine Design:** Types of load, Modes of failure, factor of safety concepts, Theories of Failure, concept and mitigation of stress concentration, Fatigue failure and curve, endurance limit and factors affecting it, Notch sensitivity, Goodman, Gerber and Soderberg criteria.

**MODULE-II (8 HOURS)**

**3. Machine Element Design:** Design of Joints: Rivets, welds and threaded fasteners based on different types of loading, Boiler joints, cotter joints and knuckle joints.

**MODULE-III (10 HOURS)**

**4. Design of Keys, Shaft and Couplings:** Classification of keys and pins, Design of keys and pins, Theories of failure, Design of shafts: based on strength, torsional rigidity and fluctuating load, ASME code for shaft design, Design of couplings: Rigid coupling, Flexible coupling.

**5. Design of Mechanical Springs:** Types of helical springs, Design of Helical springs, bulking of spring, spring surge, end condition of springs, Design of leaf springs: nipping.

**MODULE-IV (6 HOURS)**

**6. Bearings:** Types and selection of ball and roller bearings, Dynamic and static load ratings, Bearing life, Design of sliding contact bearings, Journal bearing, foot step bearing.

**TEXT BOOKS:**

1. Design of Machine Elements, V.B. Bhandari, Tata McGraw Hill
2. Mechanical Engineering Design, J.E.Shigley, C.R.Mischke, R.G.Budynas and K.J.Nisbett, TMH

**REFERENCE BOOKS:**

1. Machine Design, P.Kanaiah, Scietech Publications
2. Fundamentals of Machine Component Design by R.C.Juvinall and K.M.Marshek, John Wiley & Sons
3. Machine Drawing by N.Sidheswar, McGraw-Hill
4. Machine Design, P.C.Sharma and D.K.Agrawal, S.K.Kataria & Sons
5. Machine Design, Pandya and Shah, Charotar Book Stall
6. Machine Design, Robert L. Norton, Pearson Education Asia.
7. Design of Machine Elements by C. S. Sharma and K. Purohit, PHI

**DESIGN DATA HAND BOOKS:**

1. P.S.G. Design Data Hand Book, PSG College of Tech Coimbatore
2. Design Data Hand Book, K. Lingaiah, McGraw Hill, 2nd Ed. 2003.
3. Design Hand Book by S.M.Jalaluddin ; Anuradha Agencies Publications
4. Design Data Hand Book by K.Mahadevan and B.Reddy, CBS Publishers

### **PRACTICAL (DESIGN OF MACHINE ELEMENTS)**

1. Design of any one working model related to Design of machine elements i.e., Module I and II.
  2. Design of any one working model related to Design of machine elements i.e., Module III and IV.
  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 spring
  9. Design of bearing
- } Compulsory
- } Total no. of Drawing: 6  
3 in drawing sheets  
3 in AutoCad/Pro-E/  
CATIA/ANSYS

Total number of Design : Minimum 8 nos including 2 working model.

## **PME5I101 MACHINING SCIENCE AND TECHNOLOGY**

### **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 Machine 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

## **PRACTICAL (MACHINING SCIENCE AND TECHNOLOGY LAB.)**

(Minimum 08 Experiments/Studies)

### **LIST OF EXPERIMENTS:**

1. Job on lathe with taper turning, thread cutting, knurling and groove cutting (3 experiments).
2. Gear cutting (with index head) on milling machine
3. Working with shaper, Planner and slotting machine.
4. Working with surface and cylindrical grinding.
5. Determination of cutting force using Lathe tool dynamometer.
6. Determination of cutting force in drilling using drill tool dynamometer.
7. Study of Non-traditional machining processes.(USM, AJM, EDM, ECM)
8. Study of CNC Lathe and demonstration of making job in CNC lathe.
9. Study of CNC Milling machine and demonstration of making job in CNC Milling machine

TENTATIVE  
Likely to be Modified

## PME5I102 HEAT TRANSFER

### MODULE-I (12 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 coordinates, 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).

### MODULE-II (12 HOURS)

#### 3. Convective Heat Transfer:

Introduction to convective flow - forced and free. Dimensional analysis of forced and free convective heat transfer. Application of dimensional analysis, physical significance of Grashoff, Reynolds, Prandtl, Nusselt and Stanton numbers.

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 hydrodynamically developed flow; flow through tubes (internal flow). Use of empirical relations for solving turbulent conditions for external and internal flow.

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

### Module-III (8 hours)

#### 4. 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.

**Module-IV (8 hours)**

**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.

**6. Heat Exchangers :**

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

**Text Books :**

1. Heat Transfer Incropera and Dewitt, Wiley publications
2. Heat Transfer : J.P.Holman, TMH Publications
3. Heat Transfer: P.S.Ghosdastidar, Oxford University Press
4. Fundamentals of Engineering Heat and Mass Transfer: R.C.Sachdeva, New Age International Publishers, 4<sup>th</sup> Edition

**References :**

1. Heat Transfer by P.K. Nag, TMH
2. Heat Transfer by S.P. Sukhatme, TMH
3. Heat Transfer: A.F.Mills and V.Ganesan, Pearson Education, 2<sup>nd</sup> Edition
4. Heat and Mass Transfer: Domkundwar and Arora, Danpatrai and sons
5. Heat Transfer : R.K.Rajput, Laxmi Publications
6. Heat and Mass Transfer: A Practical Approach, Y.A.Cengel, Tata Macgraw Hills Education Private Limited

**PRACTICAL (HEAT TRANSFER LABORATORY )**

1. Determination of Thermal conductivity of composite slab
2. Determination of heat transfer coefficient in natural/forced convection.
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.

## **PME5J101 OPTIMIZATION IN ENGINEERING (PROFESSIONAL ELECTIVE)**

### **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.

#### **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
3. Prabhakar Pai, Operation Research, Oxford University Press

#### **REFERENCE BOOKS:**

1. Stephen 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.

## **PME5J102 PROJECT MANAGEMENT (PROFESSIONAL ELECTIVE)**

### **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, Prasanna 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.



**PME5D002 DESIGN OF MACHINE COMPONENTS  
(HONOURS ELECTIVE)**

**MODULE I (8 HOURS)**

1. **Design of Pressure vessels:** Thin pressure vessels: cylindrical and spherical vessels, Design of end Closures, Thick cylindrical shells.
2. **Design of Lever:** Classification, Design of levers, Cranked lever, Lever of safety - valve.

**MODULE II (8 HOURS)**

3. **Design of belt drive and power screw:** Design of belt drive and pulley, Power screw design with square thread such as screw jack.
4. **Design of clutch and brake:** Friction clutch, Cone clutch and Centrifugal clutch, Block brake, Band brake, Internal expanding shoe brake.

**MODULE III (8 HOURS)**

5. **Gears:** Design of Spur, Helical, bevel and worm gears.
6. **Flywheel:** Design of Flywheel.

**MODULE IV (8 HOURS)**

7. **Design of I.C. Engine components:** Design of Cylinder, Piston, Connecting Rod, Crank Shaft.
8. **Introduction to Finite Element Method:** FEM fundamental concepts, Procedure of FEM, Finite Element Modeling of one dimensional problems. Finite Element Analysis of 2-D problems: Shape function, Strain Displacement Relation, Element Characteristics Matrix.

**TEXT BOOKS:**

1. Design of Machine Elements, V.B. Bhandari, Tata McGraw Hill
2. Design of Machine Elements by C. S. Sharma and K. Purohit, PHI

**REFERENCE BOOKS:**

1. Mechanical Engineering Design, J.E.Shigley, C.R.Mischke, R.G.Budynas and K.J.Nisbett, TMH
2. Machine Design, P.Kanaiah, Sciotech Publications
3. Fundamentals of Machine Component Design by R.C.Juvinall and K.M.Marshek, John Wiley & Sons
4. Machine Drawing by N.Sidheswar, McGraw-Hill
5. Machine Design, P.C.Sharma and D.K.Agrawal, S.K.Kataria & Sons
6. Machine Design, Pandya and Shah, Charotar Book Stall
7. Machine Design, Robert L. Norton, Pearson Education Asia.

**DESIGN DATA HAND BOOKS:**

1. P.S.G. Design Data Hand Book, PSG College of Tech Coimbatore
2. Design Data Hand Book, K. Lingaiah, McGraw Hill, 2nd Ed. 2003.
3. Design Hand Book by S.M.Jalaluddin ; Anuradha Agencies Publications
4. Design Data Hand Book by K.Mahadevan and B.Reddy,CBS Publishers

**PME5D001    ADVANCED MECHANICS OF SOLIDS  
(Honours Elective)**

**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 Schmidt, 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

**PME5D003 EXPERIMENTAL STRESS ANALYSIS  
(Honours Elective)**

**MODULE - I (12 HOURS)**

Elementary Elasticity : Stress at a point, Principal Stresses in 2D and 3D stress systems, strain and stress-strain relations, principal strains, plane stress and plane strain problems. Theory of Photoelasticity: Photoelasticity 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 circular polariscopes. Dark field and light field arrangements.

**MODULE - II (12 HOURS)**

Photoelastic 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 Photoelasticity, 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.

## **PME5G001 MANUFACTURING PROCESSES (MINOR SPECIALIZATION)**

### **MODULE - I (16 HOURS)**

Definition and classification of manufacturing processes. Principle of casting, components of casting process including riser and gating system, pattern and types of pattern, pattern material, mould and moulding materials, properties, melting furnaces (cupola), solidification of casting, casting methods and casting defects.

Introduction to gas welding, cutting, Arc welding and equipment's. TIG (GTAW) and MIG (GMAW) welding, resistance welding and Thermit welding(Basic Principles). Brazing and soldering, welding defects.

Plastic deformation of metals. Hot and cold working of metals, classification of metal forming processes. Rolling: types of rolling mills, Rolling defects. Forging: Smith Forging, Drop and Press forging, M/c forging (Basic Principles), Forging defects.

### **MODULE - II (14 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.

### **MODULE - III (14 HOURS)**

Non-traditional Machining processes : Ultrasonic Machining, Laser Beam Machining, Plasma Arc Machining, Electro Chemical Machining, Electro Discharge Machining, Wire EDM , Abrasive Jet Machining

Concept of Flexible manufacturing process, concurrent engineering, production tools like capstan and turret lathes, rapid prototyping processes.

### **TEXT BOOKS :**

1. Manufacturing technology(Vol.I &II) by P.N.Rao, Tata McGraw Hill publication
2. Welding Technology by R.A. Little, TMH
3. A Text Book of Production Engineering (vol. I & II) by P.C.Sharma, S.Chand

### **REFERENCE BOOKS:**

1. Modern Manufacturing Processes, P.C.Pandey, H.S.Shan, Tata McGraw Hill
2. Manufacturing Science, Ghosh and Mallik, East West Press.
3. Rapid Prototyping by Amitav Ghosh

**ADVANCED LAB-I**

**PME5I201 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

## OTHER ELECTIVE

### ENERGY CONVERSION TECHNIQUES (PME5H001)

#### 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 & Hizirolu – Oxford University Press. 8.

Electric Machines – Charles Hubert – Pearson Education.

## **HUMAN RESOURCE MANAGEMENT (PME5H002)**

### **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

## MARKETING MANAGEMENT (PME5H002)

**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, Emarketing, 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.



## **C++ AND OBJECT ORIENTED PROGRAMMING (PME5H004)**

### **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.

## **INTERNET AND WEB TECHNOLOGY (PME5H005)**

### **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

## ANALOG AND DIGITAL ELECTRONICS (PME5H006) (OE)

### 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.

## DIGITAL SIGNAL PROCESSING (PME5H007)

### 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.

## QUALITY MANAGEMENT AND RELIABILITY (PME5J103)

### Module- I (8 hours)

Attributes of quality, Evolution of philosophy of Quality Management: Inspection, Quality Control, Quality Assurance, Total Quality Management, Cost of quality  
Acceptance sampling: Design of single sampling plan. Double, multiple and sequential sampling plans, O.C. curve, Producer's risk and consumer's risk, AOQ, AOQL

### Module-II (10 hours)

Statistical process control, Use of control charts and process engineering techniques for implementing quality plan, X-Chart, R-Chart, p-chart, np-chart, c-chart, cusum-chart, Process capability analysis, statistical tolerance analysis

Experimental designs and factorial experiments:  $2^k$  factorial experiments, Taguchi philosophy; Loss function; Signal to noise ratio, Orthogonal arrays for parameter and tolerance design.

### Module-III (6 hours)

Definition – Reliability vs quality; Reliability function – MTBF, MTTR, availability; Bathtubcurve – time dependent failure models – distributions – normal, weibull; Reliability of system and models – serial, parallel and combined configuration; Economic analysis and life cycle cost; Proactive, preventive, predictive maintenance; Maintainability and availability

### Module-IV (8 hours)

Quality Improvement: Fundamentals of TQM; Some important philosophies and their impact on quality (Deming, Juran, Crosby); Quality circle, QC Tools; Service Quality; Quality Standard: Product and Process Standard, Introduction to ISO 9000 and 14000 standards; Concept of Six Sigma, Lean Management and TPM

### Books

1. Quality Planning and Analysis, Juran J M and Gryna F M, TMH
2. Statistical Process Control and Improvement, A. Mitra, Pearson.
3. Introduction to Statistical Quality control, D.C. Montgonery, John Wiley & sons.
4. Introduction to /reliability and MaitainabilityEngg E. Ebeling, MC-Graw Hill.
5. Quality control and Application ,B.L. Hansen and P.M. Ghare, Prentice Hall of India.
6. Statistical Quality Control, M. Mahajan, Dhanpat Rai & Sons.
7. K C Jain and A K Chitale, Quality Assurance and Total Quality Management, Khanna Publishers
8. K.S. Krishnamoorthi& V. Ram Krishnamoorthi, "A First Course in Quality Engineering" CRC Press

B.Tech (Mechanical Engineering) detail Syllabus for Admission Batch 2015-16 *6th Semester*

Sixth Semester								
		Theory				Practical		
Code	Course Name	Hours/ Week L/T	Credit Theory	University Marks	Internal Evaluation	Hours/ Week L/T	Credit Practical	Marks
PC	Production & Operation Management	3-0	3	100	50	2	1	50
PC	Refrigeration & Air Conditioning	3-0	3	100	50	2	1	50
PE	Product Design & Production Tooling/Computer Integrated Manufacturing & FMS/CAD & CAM	3-1	4	100	50			
PE	Compressive Flow & Gas Dynamics/Automobile Engineering/ Non-Conventional Energy Sources	3-1	4	100	50			
MC & GS	Environmental Science & Engineering	3-0	3	100	50			
OE	Industrial Lecture #					3	1	50
HS	Business communication & Skill for Interview #	2-0	1		50	4	2	100
MC	Yoga					2	1	50
<b>Total</b>		<b>19</b>	<b>18</b>	<b>500</b>	<b>300</b>	<b>13</b>	<b>6</b>	<b>300</b>
<b>Total Marks: 1100</b>								
<b>Total Credits: 24</b>								
Honours	Advanced Fluid Mechanics/ Fluid Power and Turbo Machinery/ Power Plant Engineering	4	4	100	50			
Minor	Mechanics of Solid							

## B.Tech (Mechanical Engineering) detail Syllabus for Admission Batch 2015-16 *6th Semester*

SEMESTER : 6TH

1.	PME6D001	HONOURS (O3)	ADVANCED FLUID MECHANICS	4-0-0	4
2.	PME6D002	HONOURS (O3)	FLUID POWER AND TURBO MACHINERY	4-0-0	4
3.	PME6D003	HONOURS (O3)	POWER PLANT ENGINEERING	4-0-0	4
4.	PME6E101	HS (CP)	BUSINESS COMMUNICATION & SKILL FOR INTERVIEW	1-0-2	3
5.	PME6G001	MINOR (CP)	MECHANICS OF SOLID	4-0-0	4
6.	PME6H301	OE (CP)	INDUSTRIAL LECTURE #	0-0-1	1
7.	PME6I101	PC (CP)	PRODUCTION & OPERATION MANAGEMENT	3-0-1	4
8.	PME6I102	PC (CP)	REFRIGERATION & AIR CONDITIONING	3-0-1	4
9.	PME6J001	PE (O1)	PRODUCT DESIGN & PRODUCTION TOOLING	4-0-0	4
10.	PME6J002	PE (O1)	COMPUTER INTEGRATED MANUFACTURING & FMS	4-0-0	4
11.	PME6J003	PE (O1)	CAD / CAM	4-0-0	4
12.	PME6J004	PE (O2)	COMPRESSIVE FLOW & GAS DYNAMICS	4-0-0	4
13.	PME6J005	PE (O2)	AUTOMOBILE ENGINEERING	4-0-0	4
14.	PME6J006	PE (O2)	NON-CONVENTIONAL ENERGY SOURCES	4-0-0	4

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## **PME6I101 PRODUCTION AND 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

**Production and Operation Management Practical**

1. Do Work Sampling of any work situation and determine how much time is spent in value addition, inspection /checking, communication and idleness.
2. Collect layout of any industry/ institute and design layout of similar industry/ institute to be constructed on a different site.
3. Select two or more possible locations for setting up of an industry/ institute and do comparative evaluation with respect to different parameters.
4. Gather sample data about stock of different items, their consumption pattern and price from any one of the following business firms such as Automobile Repair Shop, Medicine Store, Consumer Store, Production Shop, Service Centre etc and suggest stock that should be maintained for optimizing Inventory.
5. Hands on practice on any Manufacturing Execution System (MES) software/ ERP suit such as NetSuite Manufacturing, IQMS MES Software, Fishbowl Manufacturing, JobBOSS, MES SIMATIC IT, etc.
6. Hands on practice on simulation software for manufacturing/ supply chain/ logistics, such as Arena, Witness, Flexsim, Plant Simulation, AnyLogic, Simio, etc.

**\*Students may do 2 to 3 activities individually or in group**

## **PME6I102 REFRIGERATION AND AIR CONDITIONING**

### **MODULE I (12 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 ( 12 HOURS)**

4. Vapour Absorption System : Simple Ammonia - absorption system, Improved absorption system, Analysis of vapour absorption system (Specifically of analyzing column 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 designation- 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 (10 HOURS)**

7. 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

### **MODULE IV (06 HOURS)**

8. 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 C.P. Arora, Tata McGraw Hill.
3. 2Refrigeration and Air Conditioning by S.C. Arora and S. Domkundwar, Dhanpat Rai & Sons. Chapters ; 3,4,5,6,7,11,16,17,19,20
4. Refrigeration and Airconditioning Data book by Manohar Prasad

### **REFERENCE BOOKS :**

1. Refrigeration and Air conditioning by P.L. Ballney, Khanna Publishers.
2. Refrigeration and Air conditioning by Manohar Prasad, New Age international publishers.

**PRACTICAL (REFRIGERATION & AIR CONDITIONING LAB)**

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.

**PROFESSIONAL ELECTIVES**

**PME6J001 PRODUCT DESIGN AND PRODUCTION TOOLING**

**MODULE - I (14 HOURS)**

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

Process Planning - selection of processes, machines and tools. Design of sequence of operations, Time & cost estimation

**MODULE - II (14 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. Tooling design for turret lathe and automats. Design of limit gauges.

**TEXT 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. A Textbook of Production Engineering, P.C. Sharma, S. Chand & Co

**REFERENCE BOOKS:**

1. Fundamentals of Tool Engineering design, S.K. Basu, S.N. Mukherjee, R. Mishra, Oxford & IBH Publishing co.
2. Technology of Machine Tools, Krar, Gill, Smid, Tata Mc Graw Hill
3. Jigs & Fixture Design, Edwrd G Hoffman, Cengae Learning.

## **PME6J002 COMPUTER INTEGRATED MANUFACTURING & FMS**

**(PROFESSIONAL ELECTIVE)**

### **MODULE - I (14 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 (14 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 (16 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

**PME6J003 COMPUTER AIDED DESIGN AND COMPUTER AIDED  
MANUFACTURING (CAD&CAM)**

**(PROFESSIONAL ELECTIVE)**

**MODULE - I (14 HOURS)**

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 (14 HOURS)**

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 Coordinate 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.
2. CAD & CAM, J Srinivas, Oxford University Press

**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 Concepts, K.Sareen and C.Grewal, S.Chand Publication
6. CAD/CAM/CAE, N.K.Chougule, Scitech

**PME6J004 COMPRESSIVE FLOW & GAS DYNAMICS**  
(PROFESSIONAL ELECTIVE)

**Module I: (10 hours)**

Fundamentals of Fluid dynamics and Thermodynamics: continuity equation, Momentum equation, Energy equation of incompressible flow Introduction to compressible flow: Introduction, Isentropic flow in a stream tube, speed of sound, Mach waves; One dimensional Isentropic Flow: Governing equations, stagnation conditions, critical conditions, maximum discharge velocity, isentropic relations

**Module II: (10 hours)**

Normal Shock Waves: Shock waves, stationary normal shock waves, normal shock wave relations in terms of Mach number; Oblique Shock Waves: Oblique shock wave relations, reflection of oblique shock waves, interaction of oblique shock waves, conical shock waves; Expansion Waves: Prandtl-Meyer flow, reflection and interaction of expansion waves, flow over bodies involving shock and expansion waves

**Module III: (10 hours)**

Variable Area Flow: Equations for variable area flow, operating characteristics of nozzles, convergent-divergent supersonic diffusers Adiabatic Flow in a Duct with Friction: Flow in a constant area duct, friction factor variations, the Fanno line; Flow with Heat addition or removal: One-dimensional flow in a constant area duct neglecting viscosity, variable area flow with heat addition, one-dimensional constant area flow with both heat exchanger and friction

**Module IV: (10 hours)**

Generalized Quasi-One-Dimensional Flow: Governing equations and influence coefficients, solution procedure for generalized flow with and without sonic point; Two-Dimensional Compressible Flow: Governing equations, vorticity considerations, the velocity potential, linearized solutions, linearized subsonic flow, linearized supersonic flow, method of characteristics.

**Text Books**

P. H. Oosthuizen and W. E. Carscallen. Compressible Fluid Flow. NY, McGraw-Hill, 1997.

H. W. Liepmann, and A. Roshko, Elements of Gas Dynamics, Dover Pub, 2001.

A. H. Shapiro, Compressible Fluid Flow 1 and 2. Hoboken NJ: John Wiley.

**References**

M. A. Saad, Compressible Fluid Flow. 2nd ed. Upper Saddle River, NJ: Prentice-Hall, 1993.

F. M. White, Viscous Fluid Flow. 2nd ed. New York: McGraw-Hill, 1991.

**PME6J005 AUTOMOBILE ENGINEERING**  
(PROFESSIONAL ELECTIVE)

**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, Voll & 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

**PME6J006 NON CONVENTIONAL ENERGY SOURCES**

**(PROFESSIONAL ELECTIVE)**

**MODULE I (6 CLASSES)**

1. 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),



**MODULE II (15 CLASSES)**

2. 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)
3. 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.

**MODULE III (08 CLASSES)**

4. 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),
5. 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.

**MODULE IV (08 CLASSES)**

6. Geothermal Energy: Applications, Origin and Distribution of Geothermal Energy, Types of
  - a. Geothermal Resource.
7. Ocean Energy: Tidal Energy, Wave Energy, Ocean Thermal Energy
8. Fuel Cell Technology: Types, Principle of operation, Advantages and disadvantages.

**TEXT BOOK:**

1. Solar Energy Technology: Sukhatme and Nayak, TMH
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.
4. Non Conventional Energy Sources: B.M Khan, TMH Publications

**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. Renewable Energy, Godfrey Boyle, Oxford University Press

## PMG6M001 ENVIRONMENTAL SCIENCE AND ENGINEERING

### Module I

#### Multidisciplinary nature of environmental studies

Definition, scope and importance, Need for public awareness.

#### Natural Resources:

Renewable and non-renewable resources:

Natural resources and associated problems.

- a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people.
  - b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.
  - c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
  - d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.
  - e) Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Case studies.
  - f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.
- Role of an individual in conservation of natural resources.
  - Equitable use of resources for sustainable lifestyles.

### Module II

#### Ecosystems

Concept of an ecosystem.

- Structure and function of an ecosystem.
  - Producers, consumers and decomposers.
  - Energy flow in the ecosystem.
  - Ecological succession.
  - Food chains, food webs and ecological pyramids.
  - Introduction, types, characteristic features, structure and function of the following ecosystem :-
- a) Forest ecosystem
  - b) Grassland ecosystem
  - c) Desert ecosystem
  - d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

#### Environmental Pollution Definition

- Cause, effects and control measures of :-
- a) Air pollution
  - b) Water pollution
  - c) Soil pollution
  - d) Marine pollution
  - e) Noise pollution
  - f) Thermal pollution
  - g) Nuclear hazards
- Solid waste Management: Causes, effects and control measures of urban and industrial wastes.
  - Role of an individual in prevention of pollution.

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- Pollution case studies.
- Disaster management: floods, earthquake, cyclone and landslides.

### Module III

#### Social Issues and the Environment

- From Unsustainable to Sustainable development
- Urban problems related to energy
- Water conservation, rain water harvesting, watershed management
- Resettlement and rehabilitation of people; its problems and concerns. Case Studies
- Environmental ethics : Issues and possible solutions.
- Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies.
- Wasteland reclamation.
- Consumerism and waste products.
- Environment Protection Act.
- Air (Prevention and Control of Pollution) Act.
- Water (Prevention and control of Pollution) Act
- Wildlife Protection Act
- Forest Conservation Act
- Issues involved in enforcement of environmental legislation.
- Public awareness.

### Module IV

#### Human Population and the Environment

- Population growth, variation among nations.
- Population explosion – Family Welfare Programme.
- Environment and human health.
- Human Rights.
- Value Education.
- HIV/AIDS.
- Women and Child Welfare.
- Role of Information Technology in Environment and human health.
- Case Studies.

### References

1. Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
2. R. Rajagopalan, Environmental Studies, Oxford University Press
3. Ajith Sankar, Environmental Mangement, Oxford University Press
4. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad – 380 013, India, Email:mapin@icenet.net (R)
5. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p
6. Clark R.S., Marine Pollution, Clanderson Press Oxford (TB)
7. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumabai, 1196p
8. De A.K., Environmental Chemistry, Wiley Eastern Ltd.
9. Down to Earth, Centre for Science and Environment (R)

## **PEN6E101 BUSINESS COMMUNICATION AND SKILL FOR INTERVIEW**

### **Course Objectives**

- To develop communication competence in prospective engineers.
- To enable them to convey thoughts and ideas with clarity and focus.
- To develop report writing skills.
- To equip them to face interview & Group Discussion.
- To inculcate critical thinking process.
- To prepare them on problem solving skills.
- To provide symbolic, verbal, and graphical interpretations of statements in a problem description.
- To understand team dynamics & effectiveness.
- To create an awareness on Engineering Ethics and Human Values.
- To install Moral and Social Values, Loyalty and also to learn to appreciate the rights of others.
- To learn leadership qualities and practice them.

### **MODULE I**

**Communication Skill:** Introduction to Communication, The Process of Communication, Barriers to Communication, Listening Skills, Writing Skills, Technical Writing, Letter Writing, Job Application, Report Writing, Non-verbal Communication and Body Language, Interview Skills, Group Discussion, Presentation Skills, Technology-based Communication.

### **MODULE II**

**Critical Thinking & Problem Solving:** Creativity, Lateral thinking, Critical thinking, Multiple Intelligence, Problem Solving, Six thinking hats, Mind Mapping & Analytical Thinking.

**Teamwork:** Groups, Teams, Group Vs Teams, Team formation process, Stages of Group, Group Dynamics, Managing Team Performance & Team Conflicts.

### **MODULE III**

**Ethics, Moral & Professional Values:** Human Values, Civic Rights, Engineering Ethics, Engineering as Social Experimentation, Environmental Ethics, Global Issues, Code of Ethics like ASME, ASCE, IEEE.

### **MODULE IV**

**Leadership Skills:** Leadership, Levels of Leadership, Making of a leader, Types of leadership, Transactions Vs Transformational Leadership, VUCA Leaders, DART Leadership, Leadership Grid & leadership Formulation.

### **Expected outcome:**

The students will be able to

- Communicate effectively.
- Make effective presentations.
- Write different types of reports.
- Face interview & group discussion.
- Critically think on a particular problem.
- Solve problems.

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- Work in Group & Teams
- Handle Engineering Ethics and Human Values.
- Become an effective leader.

### References:

1. Barun K. Mitra; (2011), "Personality Development & Soft Skills", First Edition; Oxford Publishers.
2. Kalyana; (2015) "Soft Skill for Managers"; First Edition; Wiley Publishing Ltd.
3. Larry James (2016); "The First Book of Life Skills"; First Edition; Embassy Books.
4. Shalini Verma (2014); "Development of Life Skills and Professional Practice"; First Edition; Sultan Chand (G/L) & Company
5. John C. Maxwell (2014); "The 5 Levels of Leadership", Centre Street, A division of Hachette Book Group Inc.

## **PME6D003 POWER PLANT ENGINEERING**

**(HONOURS ELECTIVE)**

### **MODULE-I (8 HRS)**

1. INTRODUCTION  
Different sources (Conventional and non-conventional) of energy and the principle of power generation only, Types of power plant and site selection, overall view of a steam power plant.
2. 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.

### **MODULE - II (10HRS)**

3. FLOW THROUGH NOZZLES  
Types of nozzles and their area of application & related calculation, critical pressure & choked flow, super saturated flow. Effect of friction and nozzle efficiency
4. 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.

### **MODULE - III (10HRS)**

5. 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.
6. STEAM CONDENSER & CIRCULATING WATER SYSTEMS  
Types, Surface condenser, Performance calculation, Air removal methods, Vacuum & vacuum efficiency. Cooling towers.(types, principle of operation and performance)

### **MODULE - IV (8HRS)**

7. NUCLEAR POWER PLANT

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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

### 8. 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

### TEXT BOOKS

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

### REFERENCE:

1. 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

## PME6D001 ADVANCED FLUID MECHANICS

(HONOURS ELECTIVE)

### MODULE I (08 HRS.)

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 (10 HRS.)

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 (10 HRS.)

Theory of hydrodynamic lubrication. Boundary layer: derivation, exact solutions, Blasius, Falkner Skan, series solution and numerical solutions. Approximate methods. Momentum integral method.

### MODULE IV (08 HRS.)

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

## **PME6D002 FLUID POWER AND TURBOMACHINERY**

**(Honours Elective)**

### **Module I (12 hours)**

Introduction to fluid power, Advantages of fluid power, Application of fluid power system. Types of fluid power systems, Properties of hydraulic fluids and pneumatics. Advantages and Disadvantages of Fluid control, Types of Hydraulic Fluids, physical, chemical and thermal properties of hydraulic fluids, selection of hydraulic fluid, fluid flow fundamentals. Hydraulic Pumps and Motors: Basic Types and constructions, ideal pump and motor analysis, Performance curves and parameters

Introduction to Turbomachines. Classification of Turbomachines. Second Law of Thermodynamics - turbine/compressor work, Nozzle/diffuser work. Fluid equations - continuity, Euler's, Bernoulli's equation and its applications. Expansion and compression processes, Reheat Factor, Preheat Factor. Euler's Equation of Energy Transfer, vane congruent flow, influence of relative circulation, thickness of vanes, number of vanes on velocity triangles, slip factor, Stodola, Stanitz and Balje's slip factor. Suction pressure and net positive suction head. Phenomena of cavitation in pumps. Concept of specific speed, Shape number. Axial, Radial and Mixed Flow Machines. Similarity laws.

### **Module II (10 hours)**

Flow through Axial flow fans. Principles of Axial fan and propeller. Application of fans for air circulation and ventilation. Stage pressure rise and work done. Slip stream and Blade Element theory for propellers. Performance and characteristics of Axial fans.

### **Module III (10 hours)**

Flow through Centrifugal compressors. Stage velocity triangles, specific work. forward, radial and backward swept vanes. Enthalpy entropy diagram, degree of reaction, slip factor, efficiency. Vane less and vaned diffuser systems, volute as spiral casing. Surge and stall in compressors

### **Module IV (08 hours)**

Axial turbine stages, stage velocity triangles, work, efficiency, blade loading, flow coefficient. Single stage impulse and reaction turbines, degree of reaction, 50% reaction turbine stage, Radial equilibrium and Actuator disc approach for design of turbine blades. Partial admission problems in turbines. Losses in turbo machines.

### **Text Books**

1. S.M. Yahya, Turbines, Compressors and Fans, Tata Mcgraw Hill.
2. V. Kadambi, Manohar Prasad, An introduction to energy conversion, Volume-3, new age International publishers
3. E. Rathakrishnan, Gas Dynamics, , PHI Learning Pvt. Ltd
4. Mohammed Kaleem Khan, Fluid Mechanics and Machinery, Oxford publications
5. Anthony Esposito, "Fluid power with applications", Prentice Hall, 7th Edition, 2002.

### **Reference books:**

1. Fluid Mechanics and Fluid Power Engineering by D.S. Kumar, S.K. Kataria & Sons
2. Gopalakrishnan G, Prithvi Raj D, "A treatise on Turbomachines", Scitec Publications, Chennai, 2002.
3. R.K. Turton, Principles of Turbomachinery, E & FN Spon Publishers, London & New York.
4. Herbert E. Merritt, "Hydraulic Control Systems", John Wiley & Sons, 1967

## **PME6G001 MECHANICS OF SOLID**

**(MINOR SPECIALIZATION)**

### **MODULE - I (10 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.

### **MODULE - II (11 Lectures)**

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.
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.

### **MODULE - III (8 LECTURES)**

6. Deflection of Beams :  
Differential equation of the elastic line, Slope and deflection of beams by integration method and area - moment method.
7. Theory of Columns:  
Eccentric loading of a short strut, Long columns, Euler's column formula, Lateral buckling, Critical Load, Slenderness ratio

### **MODULE - IV (7 LECTURES)**

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



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Student Edition

4. Mechanics of Materials by James M. Gere, Thomson Learning
5. Engineering Mechanics 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

TENTATIVE  
Likely to be Modified

B.Tech (Mechanical Engineering) detail Syllabus for Admission Batch 2015-16 *7th Semester*

Seventh Semester								
Code	Course Name	Theory				Practical		
		Hours/ week L/T	Credit Theory	University Marks	Internal Evaluation	Hours/ week L/T	Credit Practical	Marks
GS	Nano Science & Bio Technology	3-1	4	100	50			
PE	Mechanical Vibration/Tribology/Fatigue Creep & Fracture	3-1	4	100	50			
PE	Robotics/Simulation, Modelling & Control/Mechatronics & MEMs	3-1	4	100	50			
OE	Soft Computing */ Other subjects	3-1	4	100	50			
PC	Advance Lab-II/ Project/3D Printing					8	4	200
	Projects on Internet of Things					8	4	200
<b>Total</b>		<b>16</b>	<b>16</b>	<b>400</b>	<b>200</b>	<b>16</b>	<b>8</b>	<b>400</b>
Total Marks: 1000								
Total Credits: 24								
Honours	Computational Fluid Dynamics/ Finite Element Method / Automatic Control System	4	4	100	50			
Minor	Machine Dynamics and Design							

## B.Tech (Mechanical Engineering) detail Syllabus for Admission Batch 2015-16 *7thSemester*

SEMESTER : 7TH

1.	PME7C001	GS (CP)	NANO & BIOSCIENCE	4-0-0	4
2.	PME7D001	HONOURS (O5)	COMPUTATIONAL FLUID DYNAMICS	4-0-0	4
3.	PME7D002	HONOURS (O5)	FINITE ELEMENT METHOD	4-0-0	4
4.	PME7D003	HONOURS (O5)	AUTOMATIC CONTROL SYSTEM	4-0-0	4
5.	PME7G001	MINOR (CP)	MACHINE DYNAMICS AND DESIGN	4-0-0	4
6.	PME7H001	OE (O4)	SOFT COMPUTING	4-0-0	4
7.	PME7H002	OE (O4)	OTHER SUBJECTS	4-0-0	4
8.	PME7H201	FE (CP)	PROJECTS ON INTERNET OF THINGS	0-0-4	4
9.	PME7I201	PC (O3)	ADVANCE LAB - II	0-0-4	4
10.	PME7I202	PC (O3)	PROJECT	0-0-4	4
11.	PME7I203	PC (O3)	3D PRINTING	0-0-4	4
12.	PME7J001	PE (O1)	MECHANICAL VIBRATION	4-0-0	4
13.	PME7J002	PE (O1)	TRIBOLOGY	4-0-0	4
14.	PME7J003	PE (O1)	FATIGUE CREEP & FRACTURE	4-0-0	4
15.	PME7J004	PE (O2)	ROBOTICS	4-0-0	4
16.	PME7J005	PE (O2)	SIMULATION, MODELLING & CONTROL	4-0-0	4
17.	PME7J006	PE (O2)	MECHATRONICS & MEMS	4-0-0	4

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**SEVENTH SEMESTER**

**PROFESSIONAL ELECTIVES**

**PME7C001 NANO SCIENCE AND BIOTECHNOLOGY**

**"will be uploaded soon"**

**TENTATIVE**  
Likely to be Modified

## **PME7J001 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 without 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, Longitudinal, 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. Torsional vibration of two, three and multi-rotor systems. Dunkerley's lower bound approximate method.

**7. CONTINUOUS 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 5<sup>th</sup> ed. 2007.
2. Introductory Course on theory and Practice of Mechanical Vibrations. J.S. Rao & K. Gupta, New Age International Publication, New Delhi, 2007.

### **REFERENCE BOOKS:**

1. Mechanical Vibrations: S.S. Rao, Prarson Education Inc, 4<sup>th</sup> 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. 3<sup>rd</sup> ed., 2006
4. Elements of vibration Analysis: Leonard Meirovitch, Tata McGraw Hill, Special Indian ed., 2007

## **PME7J002 TRIBOLOGY**

**(PROFESSIONAL ELECTIVE)**

### **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

## **PME7J00 FATIGUE CREEP AND FRACTURE**

**(PROFESSIONAL ELECTIVE)**

### **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 nitriding, 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 metals, Griffith Theory of brittle Fracture, Orowan's modification to Griffith Theory.

### **MODULE – III (14 HOURS)**

**Modes of fracture :** Mode I, II and III, fatigue crack 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 : Bailey'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

**PME7J004      ROBOTICS**

**(PROFESSIONAL ELECTIVE)**

**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



## **PME7J005 SIMULATION, MODELING AND CONTROL**

**(PROFESSIONAL ELECTIVE)**

### **MODULE I 14 HOURS**

Basic simulation modeling, Discrete event simulation, Simulation of queuing and Monte Carlo simulations.

inventory systems, Continuous, Discrete-continuous and Mon

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.

## **PME7J006 MECHATRONICS**

**(PROFESSIONAL ELECTIVE)**

### **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. Histan, 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

## MICRO-ELECTRO-MECHANICAL SYSTEMS (MEMS)

(PROFESSIONAL ELECTIVE)

### 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. Ananthuresh, 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.

## **PME7D001 COMPUTATIONAL FLUID DYNAMICS**

**(HONOURS ELECTIVE)**

### **MODULE-I (10 HRS.)**

1. 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:
2. 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 (12 HRS.)**

1. The Finite Volume Method for Convection-Diffusion Problems - Introduction - Steady one-dimensional convection and diffusion -
2. 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 (08 HRS.)**

1. The Finite Volume Method for Unsteady Flows - Introduction - One-dimensional unsteady heat conduction - Explicit scheme - Crank-Nicolson scheme - The fully implicit scheme - Illustrative examples

### **MODULE-IV (08 HRS)**

1. 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.
2. Patenkar V. Subas, Numerical Heat Transfer & Fluid Flow, Taylor & Francis
3. Muralidhar, K. and Sundararajan, T., Computational Fluid Flow and Heat Transfer, Norosa Publishing House, N. Delhi.

### **REFERENCE BOOKS**

1. Ozisik, M. N. , Finite Difference Method, CRC Press.
2. Anderson, D. A. Jr, Computational Fluid Mechanics and Heat Transfer, McGraw-Hill

**PME7D002 FINITE ELEMENT METHOD**

**(HONOURS ELECTIVE)**

**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, 6<sup>th</sup> 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

## **PME7D003 AUTOMATIC CONTROL SYSTEM**

**(HONOURS ELECTIVE)**

### **MODULE I (10 HOURS)**

Introduction: Basic concept of control system, Open loop and Close loop control systems. Control System and components.

Laplace Transform: Laplace transformation, Laplace transforms theorems, inverse Laplace transform. Mathematical model of physical systems: modeling of fluid systems and thermal systems. Liquid level systems, pneumatic systems, hydraulic systems, thermal systems. Feedback Characteristics of control systems, Types of feedback, effects of different feedbacks on control systems.

### **MODULE II (16 HOURS)**

Time response analysis:

Standard input signals, Step, ramp, parabolic and impulse inputs. Time response of first and second order systems to input signals. Time response specifications, Steady state error and error constants of different types of control systems.

Concept of stability, Necessary condition for stability, Routh's stability criterion, application of Routh's criterion for linear feedback system, relative stability.

Root-locus analysis: Root locus concepts, rules for construction of root loci, root contours, systems with transportation lead and lag.

### **MODULE III (16 HOURS)**

Frequency response analysis: Bode diagrams, polar plots, Nyquist stability criterion, Stability analysis, relative stability in frequency domain.

Controllers: Proportional, derivative and integral control actions, PD, PI and PID controllers and their applications to feedback control systems.

Mathematical modeling of Dynamic systems in state space, state-space representation of mechanical and electrical systems. State equation and transfer functions, Characteristic equation, Eigenvalue and eigenvector of state matrix. Design of control systems in state space.

### **BOOKS**

1. Modern Control Engineering, K. Ogata
2. Automatic Control system, B. C. Kuo
3. Control Systems Engineering, L. J. Nagrath, M. Gopal

**PME7I201 NUMERICAL COMPUTATION & SOLIDS MODELING LAB**  
(ANY TWO FROM GROUP A, B OR C)

**(A) 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

**(B) 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

Describe and Apply the EXTRUDE and REVOLVE command to draw solid models that can not be drawn with a composition of primitives

**(C) COMPUTER SIMULATION AND ANALYSIS ON FINITE ELEMENT METHODS OR COMPUTATIONAL FLUID DYNAMICS PROBLEMS**

(four or five problems) using any software/language (MATLAB, ANSYS, NASTRAN etc.)

**BOOKS**

01. Applied Numerical Methods with MATLAB, S.C.Chapra, TMH
02. Numerical Methods for Engineers and Scientists, J.D.Hoffman, CRC Press
03. Numerical Methods, E Balagurusamy, TMH
04. Numerical Methods for Engineers, Chapra and Canale, TMH
05. MATLAB Programming for Engineers, Chapman, Thomson Learning
06. Getting Started with MATLAB, Rudra Pratap, Oxford University Press
07. Mastering MATLAB 7, Hanselman and Littlefield, Pearson Education

MINOR (CP)

**MACHINE DYNAMICS AND DESIGN (4-0-0) PME7G001**

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

**Module – I : (10 Lectures)**

**1. Kinematic fundamental:** Basic Kinematic concepts and definitions, Degrees of freedom, Elementary Mechanism : Link, joint, Kinematic Pair, Classification of kinematic pairs, Kinematic chain and mechanism, **Grübler's** criterion, Inversion of mechanism, Inversions of Four bar linkage, Single slider crank mechanism and Double slider crank mechanism.

**2. Mechanism Trains :** Gear Terminology and definitions, fundamental law of gearing, Spur, bevel, helical, worm gears. Analysis of mechanism Trains: Simple Train, Compound train, Reverted train, Epicyclic train and their applications.

**Module – II : (10 Lectures)**

**3. Friction Effects:** Friction between pivot and collars, single, multi-plate and cone clutches, friction circle, friction axis. Classification of brakes, Analysis of internal expanding shoe brake, Absorption and transmission dynamometers, Rope brake dynamometer, Belt transmission dynamometer, Belt drives, Initial tension, Effect of centrifugal tension on power transmission, Maximum power transmission capacity, Belt creep and slip.

**4. Mechanism for Control:** Turning moment diagram, Turning moment diagrams for different types of engines, Fluctuation of energy and fluctuation of speed, Dynamic Theory of Flywheel. Governors - Watt, Porter, Proell, Hartnell, Wilson-Hartnell Governor, Performance parameters: Sensitiveness, Stability, Hunting, Isochronism. Introduction to Gyroscopes, Gyroscopic forces and Couple.

**Module – III : (6 Lectures)**

**5. Mechanical Engineering Design:** Introduction to design procedure, Stages in design, Code and Standardization, Interchangeability, Preferred numbers, Fits and Tolerances, Design requirements – properties of materials, Material selection, Use of Data books.

**6. Fundamentals of Machine Design:** Types of load, Modes of failure, factor of safety concepts, concept and mitigation of stress concentration, Fatigue failure and curve, endurance limit and factors affecting it, Notch sensitivity.

**Module – IV : (10 Lectures)**

**7. Machine Element Design:** Design of Joints: Rivets and welds based on different types of loading, Boiler joints, Socket and Spigot cotter joint and knuckle joint.

**8. Design of Keys, Shaft and Couplings:** Classification of keys, Design of keys, Theories of failure, Design of shafts: based on strength, torsional rigidity and fluctuating load, ASME code for shaft design, Design of couplings: Rigid coupling, Flexible coupling.



**Text Books**

1. Kinematics and Dynamics of Machinery by R L Norton, Tata MacGraw Hill
2. Theory of Machines and Mechanisms by John J. Uicker Jr., Gordon R. Pennock and Joseph E. Shigley, Oxford University Press
3. Theory of Machines by S.S.Rattan, Tata MacGraw Hill
4. Design of Machine Elements, V.B. Bhandari, Tata McGraw Hill
5. Mechanical Engineering Design, J.E.Shigley, C.R.Mischke, R.G.Budynas and K.J.Nisbett, TMH

**Reference Books**

1. Theory of Machines by Thomas Bevan, CBS Publications
2. Mechanism and Machine Theory by J.S.Rao and R.V.Dukipatti, New Age International.
3. Theory of Mechanisms and Machines by A. Ghosh & A. K. Mallick, East West Press.  
Machine Design, P.C.Sharma and D.K.Agrawal, S.K.Kataria& Sons
4. Machine Design, Robert L. Norton, Pearson Education Asia.
5. Design of Machine Elements by C. S. Sharma and K. Purohit, PHI

**DESIGN DATA HAND BOOKS:**

1. P.S.G. Design Data Hand Book, PSG College of Tech Coimbatore
2. Design Data Hand Book, K. Lingaiah, McGraw Hill, 2nd Ed. 2003.
3. Design Hand Book by S.M.Jalaluddin ; Anuradha Agencies Publications
- 4 .Design Data Hand Book by K.Mahadevan and B.Reddy,CBS Publisher.

## 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. VijayaLaxmiPai, Prentice Hall, India, May'2006- LakshmiPai
2. Principle of Soft Computing, S.N. Sivanandan& S.N. Deepa, Wiley India Edition,2010.

**PROFESSIONAL ELECTIVE**

**MECHATRONICS AND MICRO ELCTRO MECHANICAL SYSTEMS**

**(PME7J006)**

**MODULE 1 (10 HOURS)**

Evolution of Mechatronics, components of mechatronic system, types of mechatronic products, Signal theory, signal analysis and processing. Basic electronics devices: junction diodes, Bipolar transistors Basic Digital Technology: Digital number system, Binary number system, Hexadecimal number system, Binary addition, Boolean Algebra, Logic function, Universal GATES, FLIP-FLOP, Registers counters.

**MODULE II (10 HOURS)**

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

**MODULE III (10 HOURS)**

Overview of MEMS and Microsystems. Micromachining Techniques: Silicon as material for micromachining, Photolithography, thin film deposition, doping, wet and dry etching, surface and bulk micromachining, Wafer bonding, packaging.

**MODULE IV (10 HOURS)**

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. MEMS Applications: Mechanical sensors and actuators: Piezoresistive pressure sensors, MEMS capacitive accelerometer, Gyroscopes, Piezoelectric actuators.

**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. Micro and Smart Systems, G.K. Ananthuresh, K.J. Vinoy, S. Gopalakrishnan, K.N. Bhat and V.K. Atre, Wiley India, New Delhi, 2010.
4. N.P. Mahalik: MEMS, Tata McGraw-Hill, New Delhi, 2007.

**REFERENCE BOOKS:**

1. 3. Mechatronics, D.G. Alciator, M.B. Histan, Tata McGraw Hill
2. Mechatronics, A.Smaili& F Mrad, Oxford University Press
3. Mechatronics, K.P.ramchandran, G,K Vijay Raghavan, M. S Balachandran
4. Mechatronics AnIntgrated approach, Clarence W de Sliva, CRC Press
5. T. Hsu: MEMS and Microsystems: Design and Manufacture, Tata McGraw-Hill, New Delhi, 2002.