

# BIJU PATNAIK UNIVERSITY OF TECHNOLOGY, ORISSA

<u>3<sup>rd</sup> SEMESTER</u>				<u>4<sup>th</sup> SEMESTER</u>				
<i>THEORY</i>		<i>Contact Hours</i>		<i>THEORY</i>		<i>Contact Hours</i>		
<i>Code</i>	<i>Subject</i>	<i>L-T-P</i>	<i>Credits</i>	<i>Code</i>	<i>Subject</i>	<i>L-T-P</i>	<i>Credits</i>	
BSCM1205	Mathematics – III	3-1-0	4	BSCM1210	Mathematics – IV	3-1-0	4	
HSSM3204	Engineering Economics & Costing	3-0-0		HSSM3205	Organisational Behaviour	3-0-0		
	OR		3		OR		3	
HSSM3205	Organisational Behaviour	3-0-0		HSSM3204	Engineering Economics & Costing	3-0-0		
PCAT4201	Fluid Mechanics & Machinery	3-1-0	4	PCAT4203	<b>Kinematics &amp; Dynamics of Machines</b>	3-1-0	4	
PCME4203	Introduction to Physical Metallurgy & Engg Materials	3-1-0	4	PCAT4204	Automotive Engines	3-1-0	4	
PCAT4202	Automotive Thermodynamics	3-1-0	4	PCME4206	<b>Basic Manufacturing Processes</b>	3-0-0	3	
PCME4202	Mechanics of Solids	3-0-0	3	PCAT4205	Automotive Chasis	3-0-0	3	
			<b>Credits (Theory)</b>	22			<b>Credits (Theory)</b>	21
	<b>PRACTICALS/SESSIONALS</b>				<b>PRACTICALS/SESSIONALS</b>			
PCME7202	Mechanical Engg. Lab (Applied Mechanics, FM & Hy. Machines)	0-0-3	2	PCAT7201	Basic Manufacturing Process	0-0-3	2	
PCME7201	Machine Drawing Laboratory	*1-0-3	3	PCAT7202	Auto Servicing & Maintenance Lab	0-0-3	2	
				PCAT7203	Material Testing & Fluid Power Laboratory	0-0-3	2	
			<b>Credits (Practicals / Sessionals)</b>	5			<b>Credits (Practicals/ Sessionals)</b>	6
<b>TOTAL SEMESTER CREDITS</b>			27	<b>TOTAL SEMESTER CREDITS</b>			27	
<b>TOTAL CUMULATIVE CREDITS</b>				<b>TOTAL CUMULATIVE CREDITS</b>				

\* – There will be no University examination but internal examination at institute level for theory in Machine Drawing.

## BSCM1205 **Mathematics - III**

### **Module-I (18 hours)**

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

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

Complex Analysis:

Analytic function, Cauchy-Riemann equations, Laplace equation, Conformal mapping,

Complex integration: Line integral in the complex plane, Cauchy's integral theorem, Cauchy's integral formula, Derivatives of analytic functions

### **Module –III (10 hours)**

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

### **Text books:**

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

### **Reference books:**

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

## HSSM3204 **Engineering Economics & Costing**

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

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

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

Time value of money – Simple and compound interest, Cash flow diagram, Principle of economic equivalence. Evaluation of engineering projects – Present worth method, Future worth method, Annual worth method, internal rate of return method, Cost-benefit analysis in public projects. Depreciation policy, Depreciation of capital assets, Causes of depreciation, Straight line method and declining balance method.

### **Module-III: (12 hours)**

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

### **Text Books:**

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

### **Reference Books :**

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

## HSSM 3205 **Organizational Behaviour**

### **Module I :**

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

### **Module II :**

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

### **Module-III :**

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

### **Text Books :**

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

### **Reference Books :**

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

## Fluid Mechanics and Machinery (3-1-0)

### Module I

**Introduction:** Classification of fluids. Properties of fluids: viscosity, Newton's laws of viscosity, surface tension, capillarity etc.

**Fluid Statics:** hydrostatic law, measurement of pressure with different manometers, Total pressure and Centre of pressure for Plane and curved surfaces, Buoyancy and stability of floating bodies, metacentric height .

**Fluid Dynamics:** Laws of kinematics of fluid flow. Lagrangian and Eulerian method. Convective and local acceleration, Stream line , Streak line and path line, concept of circulation and vorticity, Continuity equation in differential form, Stream function and potential functions with inter relations, concept of flow nets.

### Module II

**Energy equations:** Bernoulli's equations and its applications in pitot static tube, venturimeter, and orifice meter, energy correction factor, Momentum equation, Applications of momentum equations in pipe bends, impact of jets on moving and stationary ,plane and curved vanes, moment of momentum equations, force exerted on a series of radial curved vanes

**Dimensional Analysis:** Buckingham's theorem, Non-dimensional numbers, similarities of flow. Model studies.

**Laminar and Turbulent Flows:** Reynolds experiments. Shear stress and velocity distribution for viscous flow through circular pipes and flat plates, Hagen Poiseuille's equation, concept of boundary layer theory and separation of fluid flow, causes of turbulence, Characteristics of turbulent flow.

Flow through pipes: major and minor energy losses in pipes, pipes in series and parallel, equivalent cavitation, water hammer

### Module III

**Flow around submerged bodies:** basic concept of lift and drag, coefficient of lift and drag.

**Fluid Machinery:** Pumps: Principles of operations and work done of centrifugal pumps, efficiencies, specific speed ,net positive suction head, problems, Principles and working of gear, vane and reciprocating pumps.

Turbines: classification, Principles of operations and work done Pelton, Francis and Kaplan, efficiencies, specific speed,.

### Text books:

- 1 R.K.Bansal, Fluid mechanics and Machinery, Laxmi Publications. 2005
- 2 S.K.Som, G. Biswas, Introduction To Fluid Mechanics And Fluid Machines, TataMcGraw Hill 2008

### References:

- 3 Modi and Seth: Fluid Mechanics and Hydraulic Machines, Standard Publications, New delhi
- 4 Jagdish Lal: fluid Mechanics and Hydraulic Machines, Metropolitan Books Pvt. Ltd, New Delhi
- 5 Streeter and Wiley , Fluid Mechanics, McGraw Hill Pub. 1983
- 6 A.K.Jain, Fluid Mechanics, Khanna Pub.
- 7 Domkundwar and Domkundwar, Fluid mechanics and Hydraulic Machines, Dhanpat Rai Publication. 2006
8. R.K.Rajput , A text Book Of Hydraulic Machines, S. Chand and Co. 2002

# PCME4203 Introduction to Physical Metallurgy and Engineering Materials

## MODULE-I (16 Lectures)

Classification of Engineering Materials, Engineering properties of materials. Characteristic property of metals, bonding in solids, primary bonds like ionic, covalent and metallic bond, crystal systems, common crystal structure of metals, representations of planes and directions in crystals, atomic packing in crystals, calculation of packing density, voids in common crystal structures and imperfections crystals. Concept of plastic deformation of metals, critical resolve shear stress, dislocation theory, deformation by slip and twin, plastic deformation in polycrystalline metals, yield point phenomenon and related effects, concept of cold working preferred orientation. Annealing ; recovery; recrystallization and grain growth; hot working.

## MODULE-II (16 Lectures)

Concept of alloy formation, types of alloys, solid solutions, factors governing solids solubility viz. size factor, valency factor, crystal structure factor and chemical affinity factor; order-disorder transformation. Binary phase diagrams a) Isomorphism system, (b) Eutectic system, (c) Peritectic system, (d)Eutectoid system and (e) Peritectoid system. Allotropic transformation. Lever rule and its application, Interpretation of solidification behaviors and microstructure of different alloys belonging to those systems, Effect of non-equilibrium cooling, coring and homogenization.

Iron-cementite and iron-graphite phase diagrams, microstructure and properties of different alloys (alloy steels; stainless steel, tool steel, HSS, high strength low alloy steel) types of cast iron, their microstructures and typical uses. Specification of steel.

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

## MODULE-III (12 Lectures)

Optical properties of Materials: Scattering, Refraction, Theory of Refraction and absorption, Atomic Theory of optical properties. Lasers, Optical fibres- Principle, structure, application of optical fibres.

Plastic:- Thermosetting and thermoplastics.

Ceramics: Types, structure, Mechanical properties, application

Composite Materials: Agglomerated Materials: Cermets .Reinforced Materials: Reinforced Concrete. Glass fiber reinforced plastics, Carbon fibre reinforced plastics, fibre reinforced plastics, Laminated plastic sheets. Tefnol, Properties of composites, Metal matrix composites, manufacturing procedure for fiber reinforced composite. Introduction to Nano-materials

### Text Books:

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

### Reference Books

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

# AUTOMOTIVE THERMODYNAMICS (3-1-0)

## Module-I (13 Hours)

1. Review of First and Second laws: First law analysis of unsteady flow control volumes, Entropy generation, Reversible work, Availability, and Irreversibility.
2. Gas and Vapour Power cycle: Air standard cycles- Otto, Diesel, Dual Combustion and Brayton cycles, The Brayton cycle with non-isentropic flow in compressors and turbines, The Brayton cycle with regeneration, reheating and intercooling, ideal jet propulsion cycle. The Carnot vapor cycle and its limitations, The Rankine cycle, Means of increasing the Rankine cycle efficiency, In brief concepts of the binary vapour cycle, the gas-vapor coupled cycles, Cogeneration (Back pressure and Pass-out turbines).

## Module- II (15 Hours)

3. Fuels and Combustion:  
Fuels: solid, liquid and gaseous, Chemical equations – conservation of mass, 1st law applied to combustion process, calorific value of the fuel, calorific value of fuels, efficiency of combustion processes, limitations of thermodynamic analysis. Alternative fuels for automobiles
4. Refrigeration and air conditioning  
Principles of refrigeration, Vapour compression and vapour absorption system, COP, properties of refrigeration, Psychometric, Type of air conditioning system.

## Module- III (12 Hours)

5. Basics of Gas dynamics and Isentropic flow through Nozzles
6. 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.  
Centrifugal and axial flow compressor, blowers and fans: Components, working principles and applications.

## Text Books

1. Basic and Applied thermodynamics, P.k.Nag, TMH publications
2. Fundamentals of Engineering Thermodynamics, E. Rathakrishnan (PHI)
3. Engineering Thermodynamics, Mayhew A and Rogers B, Longman Green and Co Ltd., ELBS Edition, 1990

## Reference

4. A course in Thermodynamic and Heat Engine: Kothandaraman and Domkundwar, Dhanpat Rai publication
5. Applied Thermodynamics: P.L.Balany, Khanna publications
6. Engineering Thermodynamics: R.K.Rajput, S. Chand and Co

## PCME4202 **Mechanics of Solids**

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

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

### **MODULE - II (13 Lectures)**

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

### **MODULE - III (12 Lectures)**

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

### **TEXT BOOKS**

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

### **REFERENCE BOOKS**

1. Mechanics of Materials by Beer and Johnston, Tata McGraw Hill
2. Mechanics of Materials by R.C.Hibbeler, Pearson Education
3. Mechanics of Materials by William F.Riley, Leroy D.Sturges and Don H.Morris, Wiley Student Edition
4. Mechanics of Materials by James M. Gere, Thomson Learning
5. Engineering 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

## Sessional/Practical

### Mechanical Engineering Laboratory (0-0-3) Credits: 02

#### Applied Mechanics Lab.

- 1 Determination of Moment of Inertia of Flywheel,
- 2 Determination of velocity ratio and efficiency of Screw jack
- 3 Determination of velocity ratio and efficiency of winch crab
- 4 Deflection of beam

#### Fluid Mechanics Lab

1. Determination of met centric height
2. Verification of Bernoulli's Theorem
- 3 Determination of CD and CV of Venturimeter and Orifice meter
4. Determination of coefficient of friction for flow through pipes

#### Measurement of Basic Parameters

1. Measurement of Pressure ( Manometer, Pressure gauge)
2. Measurement of Temperature (Thermocouples and resistance thermometer)
3. Measurement of Fluid Flow (Rotameter, turbine flow meter)
4. Measurement of Velocity (Orificemeter)
5. Measurement of Speed ( contact and non-contact type)

***N.B.: Total experiments to be conducted 12 and minimum 3 experiments form each group.***

## **Machine Drawing(1-0-3) Credits:03**

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, connecting rod, Piston and piston assembly and valves.

Fundamentals of AutoCAD (Two classes)

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

Drawing of the following using AUTOCAD: (Any two)

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

### **Text Books:**

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

### **Reference Books:**

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

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