BIJU PATNAIK UNIVERSITY OF TECHNOLOGY, ODISHA
ROURKELA

B. Tech (AERONAUTICAL ENGINEERING)

SEMESTER III

(Applicable to the students admitted from the Academic year 2012 – 2013 onwards)

Code No.	Course Title	L	T	P	C
THEORY					
BSCM 1205	Mathematics - III	3	1	0	4
PCME 4201	Fluid Mechanics and Hydraulic Machines	3	1	0	4
PCAE 1202	Aero Engineering Thermodynamics	3	1	0	4
PCAE 1203	Solid Mechanics	3	1	0	3
PCAE 1201	Mechanics of Machines	3	1	0	3
PCAE 1205	Elements of Aeronautics	3	1	0	4
PRACTICAL					
PCAE 7201	Strength of Materials Lab	0	0	3	2
PCAE 7202	Fluid Mechanics and Machinery Lab	0	0	3	2
PCAE 7203	Thermodynamics Lab	0	0	3	2

BSCM1205 **Mathematics - III**

Module-I (18 hours)
Partial differential equation of first order, Linear partial differential equation, Non-linear partial
differential equation, Homogenous and non-homogeneous partial differential equation with
constant co-efficient, Cauchy type, Monge's method, Second order partial differential equation
The vibrating string, the wave equation and its solution, the heat equation and its solution, Two
dimensional wave equation and its solution, Laplace equation in polar, cylindrical and spherical coordinates, potential.

Module-II (12 hours)
Complex Analysis:
Analytic function, Cauchy-Riemann equations, Laplace equation, Conformal mapping, Complex integration: Line integral in the complex plane, Cauchy's integral theorem, Cauchy's integral formula, Derivatives of analytic functions.

Module –III (10 hours)
Power Series, Taylor's series, Laurent's series, Singularities and zeros, Residue integration
method, evaluation of real integrals.

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

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

PCME4201 **Fluid Mechanics and Hydraulic Machines**

Module I (13 Lectures)

Introduction : Scope of fluid mechanics and its development as a science Physical property of Fluid: Density, specific gravity, specific weight, specific volume, surface tension and capillarity, viscosity, compressibility and bulk modulus, Fluid classification.

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

Hydrostatic process on submerged surface, force on a horizontal submerged plane surface, force on a vertical submerged plane surface. Buoyancy and floatation, Archimedes' principle, stability of immersed and floating bodies, determination of metacentric height.

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

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

Module II (12 Lectures)

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

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

Module III (15 Lectures)

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

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

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

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

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

Text Books

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

Reference Books:

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

PCAE 1203 SOLID MECHANICS (3 1 0)

OBJECTIVE

To give brief descriptions on the behaviour of materials due to axial, bending and torsional and combined loads.

MODULE – I (14 Lectures)

Stress and Strain – Hooke's Law – Elastic constants and their relationship– Statically determinate cases - statically indeterminate cases –composite bar. Thermal Stresses – stresses due to freely falling weight.

Stresses in thin circular cylinder and spherical shell under internal pressure – volumetric Strain. Combined loading – Principal Stresses and maximum Shear Stresses – Analytical and graphical methods.

MODULE – II (16 Lectures)

SHEAR, BENDING MOMENT AND SHEAR STRESSES

Shear force and bending moment diagrams for simply supported and cantilever beams-Bending stresses in straight beams-Shear stresses in bending of beams with rectangular, I & T etc cross sections-beams of uniform strength

DEFLECTION OF BEAMS

Double integration method – McCauley's method - Area moment method – Conjugate beam method- Principle of super position- Castigliano's theorem and its application.

MODULE - III (10 Lectures)

Torsion of circular shafts - shear stresses and twist in solid and hollow circular shafts – closely coiled helical springs.

TEXT BOOKS

1. Nash William – "Strength of Materials", TMH, 1998
2. Timoshenko.S. and Young D.H. – "Elements of strength materials Vol. I and Vol. II"., T. Van Nostrand Co-Inc Princeton-N.J. 1990.
3. S. Ramamrutham – "Strength of Materials"

REFERENCES

1. Dym C.L. and Shames I.H. – "Solid Mechanics", 1990.

PCAE 1202 AERO ENGINEERING THERMODYNAMICS

OBJECTIVE

To give a brief background of application of various laws of thermodynamics and its application in heat transfer, refrigeration and air-conditioning, jet propulsion system.

Module I (13)

Review of First and Second laws:

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

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

Classification and working principle of compressors (Descriptive Treatment). Isothermal and sentropic efficiency of air compressors.

Module II (12)

Otto, Diesel, Dual combustion and Brayton combustion cycles – Air standard efficiency - Mean effective pressure – Actual and theoretical PV diagrams of two stroke and four stroke IC Engines- Rankine cycle.

Module III (15)

Application of continuity, momentum and energy equations- Isentropic flow of ideal gases through nozzles - Simple jet propulsion system - Thrust rocket motor – Specific impulse.

Principles of refrigeration, Air conditioning - Heat pumps - Vapour compression – Vapour absorption types - Coefficient of performance, Properties of refrigerants.

TEXT BOOKS

1. Rathakrishnan, E, “Fundamentals of Engineering Thermodynamics”, Prentice – Hall, India.

2. Nag. P.K., “Engineering Thermodynamics”, Tata McGraw-Hills Co., Ltd., Seventh Edn., 1993

3. Yunus A.Cengal. “Thermodynamics an Engineering Approach”, TMH Ltd., 3rd Edition, 2002.

REFERENCES

1. Mayhew, A. and Rogers, B., “Engineering Thermodynamics”, Longman Green & Co. Ltd., London, E.L.B.S. Edition, 1990.

2. Van Wylen, G.J. and Sonntag, R.E., “Fundamentals of Classical Thermodynamics (S.I.Version)”, Second Edition, 1986.

3. Bacon, D.H., “Engineering Thermodynamics”, Butterworth & Co., London, 1989.

4. Saad, M.A., “Thermodynamics for Engineers”, Prentice-Hall of India Pvt. Ltd., 1989.

5. Reynolds, “Thermodynamics”, Int. Student Edn., McGraw-Hill Book Co., Ltd., 1990

PCAE 1201 **MECHANICS OF MACHINES (3 1 0)**

OBJECTIVE

To expose the students the different mechanisms, their method of working, Forces involved and consequent vibration during working

MODULE-I (15 Lectures)

MECHANISMS

Machine Structure – Kinematic link, pair and chain – Grueblers criteria – Constrained motion – Degrees of freedom - Slider crank and crank rocker mechanisms – Inversions – Applications – Kinematic analysis of simple mechanisms – Determination of velocity and acceleration.

FRICTION

Friction in screw and nut – Belt (flat and V) and rope drives. Ratio of tensions – Effect of centrifugal and initial tension – Condition for maximum power transmission – Open and crossed belt drive.

MODULE-II (10 Lectures)

GEARING AND CAMS

Gear profile and geometry – Nomenclature of spur and helical gears – Gear trains: Simple, compound gear trains and epicylic gear trains - Determination of speed and torque - Cams – Types of cams – Design of profiles – Knife edged, flat faced and roller ended followers with and without offsets for various types of follower motions

MODULE-III (15 Lectures)

UNIT IV BALANCING

Static and dynamic balancing – Single and several masses in different planes –— Single and multi cylinder engines (Inline) – Balancing of radial V engine – direct and reverse crank method

UNIT V VIBRATION

Free, forced and damped vibrations of single degree of freedom systems – Force transmitted to supports – Vibration isolation – Vibration absorption – Torsional vibration of shaft

TEXT BOOKS

1. Rattan.S.S, “Theory of Machines”, Tata McGraw–Hill Publishing Co, New Delhi,2004.
2. Ballaney.P.L, “Theory of Machines”, Khanna Publishers, New Delhi, 2002.

REFERENCES

1. Rao, J.S and Dukkipati, R.V, “Mechanism and Machine Theory”, Second Edition, Wiley Eastern Ltd., 1992.
2. Malhotra, D.R and Gupta, H.C., “The Theory of Machines”, Satya Prakasam, Tech. India Publications, 1989.
3. Gosh, A. and Mallick, A.K., “Theory of Machines and Mechanisms”, Affiliated East West Press, 1989.
4. Shigley, J.E. and Uicker, J.J., “Theory of Machines and Mechanisms”, McGraw-Hill, 1980.
5. Burton Paul, “Kinematics and Dynamic of Planer Machinery”, Prentice Hall, 1979.

PCAE 1205 ELEMENTS OF AERONAUTICS (3 1 0)

OBJECTIVE

To introduce the basic concepts of aerospace engineering and the current developments in the field.

MODULE-I (14 Lectures)

AIRCRAFT CONFIGURATIONS

Brief History-Components of an airplane and their functions. Different types of flight vehicles, classifications. Basic instruments for flying,

INTRODUCTION TO PRINCIPLES OF FLIGHT

Physical properties and structure of the atmosphere, Temperature, pressure and altitude relationships, Evolution of lift, drag and moment. Different types of drag

MODULE-II (18 Lectures)

INTRODUCTION TO AERODYNAMICS

Aerodynanic forces on aircraft – classification of NACA aerofoils, aspect ratio, wing loading, Mach number,centre of pressure and aerodynamic centre-aerofoil characteristicslift, drag curves.

INTRODUCTION TO AIRPLANE STRUCTURES AND MATERIALS

General types of construction, Monocoque, semi-monocoque. Typical wing and fuselage structure. Metallic and non-metallic materials, Use of aluminium alloy, titanium, stainless steel and composite materials.

MODULE-III (8 Lectures)

POWER PLANTS USED IN AIRPLANES

Basic ideas about piston, turboprop and jet engines, Use of propeller and jets for thrust production. Comparative merits, Principles of operation of rocket, types of rockets and typical applications, Exploration into space.

TEXT BOOKS

1..Anderson, J.D., “Introduction to Flight”, McGraw-Hill, 1995.

REFERENCE

1..Kermode, A.C., “Flight without Formulae”, McGraw-Hill, 1997.