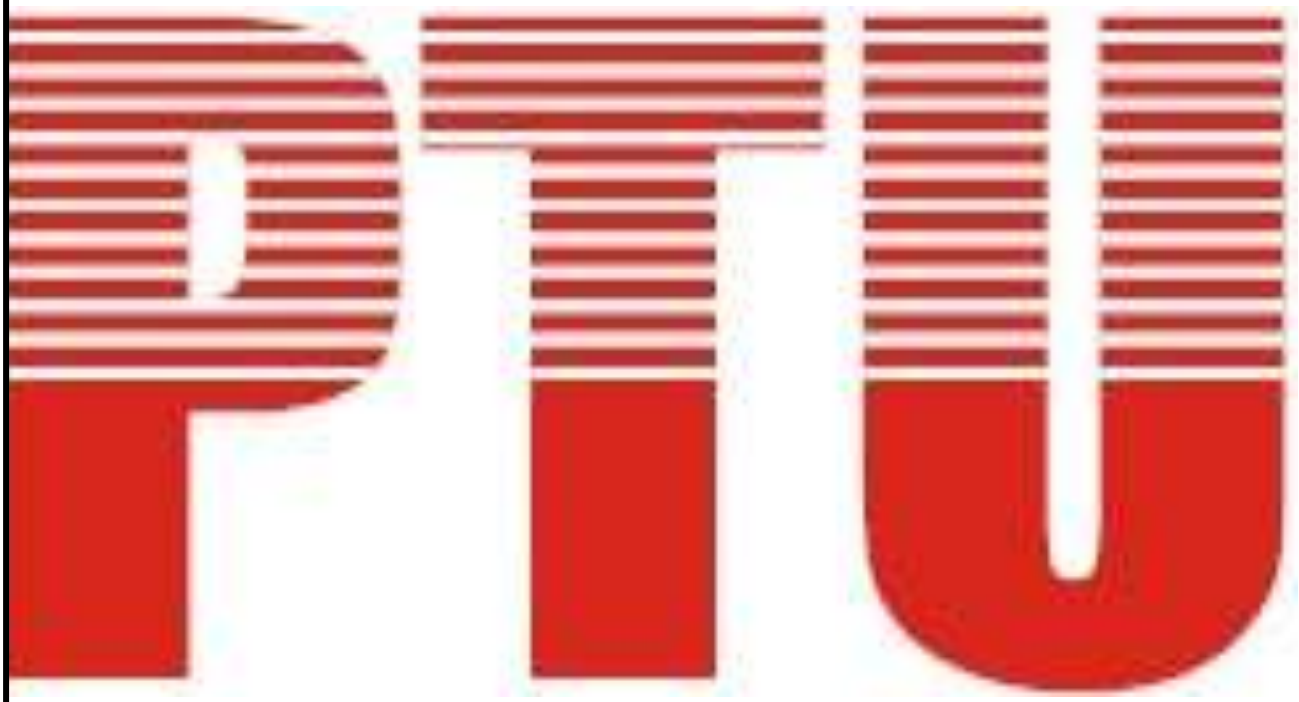
Scheme and Syllabus
of
B. Tech. Aeronautical Engineering
(3rd to 8th Semester)

Batch 2010



By
Department of Academics
Punjab Technical University

Third Semester **Contact Hours: 32 Hrs.**

Course Code	Course Name	Load Allocation			Marks Distribution		Total Marks
		L	T	P	Int.	Ext.	
ME 206	Fluid Mechanics	3	1	0	40	60	100
AM 201	Mathematics - III	3	1	0	40	60	100
AE 201	Introduction To Aeronautics	3	1	0	40	60	100
AE 203	Aerodynamics - I	4	1	0	40	60	100
ME 201	Strength Of Materials - I	3	1	0	40	60	100
ME 207	Machine Drawing	1	0	6	40	60	100
AE 205	Workshop Training Of 4 Weeks Duration After 2nd semester				60	40	100
ME 211	Strength of Materials Lab	0	0	2	30	20	50
ME 214	Fluid Mechanics Lab	0	0	2	30	20	50
Total		**17**	**5**	**10**	**360**	**440**	**800**

ME 206 Fluid Mechanics-I

PART-A

1. **Fluid and their properties**: Concept of fluid, difference between solids, liquids and gases; ideal and real fluids; capillarity, vapour pressure, compressibility and bulk modulus; Newtonian and non-Newtonian fluids.
2. **Fluid Statics**: Concept of pressure, Pascal's law and its engineering applications, Hydrostatic paradox. Action of fluid pressure on a plane (horizontal, vertical and inclined) submerged surface, resultant force and center of pressure, force on a curved surface due to hydrostatic pressure. Buoyancy and flotation, stability of floating and submerged bodies, metacentre height and its determination, periodic time of oscillation, pressure distribution in a liquid subjected to constant horizontal/ vertical acceleration, rotation of liquid in a cylindrical container.
3. **Fluid Kinematics** : Classification of fluid flows, velocity and acceleration of fluid particle, local and convective acceleration, normal and tangential acceleration, streamline, path line and streak line, flow rate and discharge mean velocity, continuity equation in Cartesian and cylindrical, polar coordinates. Rotational flows, rotation velocity and circulation, stream and velocity potential functions, flow net.

PART-B

4. **Fluid Dynamics** : Euler's equation, Bernoulli's equation and steady flow energy equation; representation of energy changes in fluid system, impulse momentum equation, kinetic energy and momentum correction factors, flow along a curved streamline, free and forced vortex motions.
5. **Dimensional Analysis and Similitude**: Fundamental and derived units and dimensions, dimensional homogeneity. Rayleigh's and Buckingham's Pi method for dimensional analysis. Dimensionless numbers and their significance, geometric, kinematic and dynamic similarity, model studies. Laminar and Turbulent Flows: Flow regimes and Reylods number, critical velocity and critical Reynolds number, laminar flow in circular cross- section pipes. Turbulent flows and flow losses in pipes, Darcy equation, minor head losses in pipes and pipe fittings, hydraulic and energy gradient lines.
6. **Flow Measurement**: Manometers, pitot tubes, venturi meter and orifice meters, orifice, mouthpieces, notches and weirs, rotameter.

Suggested Readings / Books:

1. Fluid Mechanics and Fluid Power Engineering by D.S. Kumar : S.K. Kataria and Sons Publishers.
2. Mechanics of Fluids by Massey BS; Van Nostrand Reinhold Co.
3. Fluid Mechanics by Douglas JF, Gasiorek JM, Swaffield JP; Poitman

4. Fluid Mechanics by Streetes VL and Wylie EB; Mcgraw Hill Book Co.

AM-201 MATHEMATICS-III

PART-A

1. Fourier Series Periodic functions, Euler's formula. Even and odd functions, half range expansions, Fourier series of different wave forms.

2. Laplace Transforms Laplace transforms of various standard functions, properties of Laplace transforms, inverse Laplace transforms, transform of derivatives and integrals, Laplace transform of unit step function, impulse function, periodic functions, applications to solution of ordinary linear differential equations with constant coefficients, and simultaneous differential equations.

3. Special Functions Power series solution of differential equations, Frobenius method, Legendre' equation, Legendre polynomial, Bessel's equation, Bessel functions of the first and second kind. Recurrence relations, equations reducible to Bessel's equation, Error function and its properties.

PART-B

4. Partial Differential Equations Formation of partial differential equations, Linear partial differential equations, homogeneous partial differential equations with constant coefficient Applications: Wave equation and Heat conduction equation in one dimension. Two dimensional Laplace equation, solution by the method of separation of variables. Laplacian in polar coordinates.

5. Functions of Complex Variable Limits, continuity, derivative of complex functions, analytic function, Cauchy-Riemann equation, conjugate functions, harmonic functions; Conformal Mapping: Mapping of a complex function, conformal mapping, standard transforms, mapping of standard elementary transformations, complex potential, applications to fluid flow problems; Complex Integration : Line integrals in the complex plane, Cauchy's theorem, Cauchy's integral formula and derivatives of analytic function. Taylor's and Laurent's expansions, singular points, poles, residue, complex integration using the method of residues, evaluation of real integrals by contour integration.

Suggested Readings / Books

1. Advanced Engineering Mathematics by Kreyszing Erwin ; Wiley Eastern, New Delhi
2. Higher Engineering Mathematics by BS Grewal : Khanna Publishers, New Delhi.
3. Numerical Solutions of Differential Equations by NK Jain ; Prentice Hall, Delhi.
4. Differential Equations by Sharma and Gupta ; Krishna Prakashan Media (P) Ltd., Meerut.

AE 201 Introduction to Aeronautics

PART-A

1. Introduction

History of aviation, History of space flight, History of Indian space experience, Pre Wright Brothers era, Wright Flyer, Conventional airplane, progress in airplane design and applications, Current status. Other kinds of heavier than air vehicles, helicopter, VSTOL machines.

Symbology of aerospace : US Deptt of defence Aerospace Vehicle Designation,

Vehicle Type Symbol : G-H-Q-S-V-Z; Basic Mission Symbols : A-B-C-E-F-AL-O-P-Q-S-T-U-X; Modified Mission Symbols : A-C,D,E,F,H,K,L,M,O,P,Q,R,S,T,U,V,W; Rocket Symbols : B,M,N,R,S; Manufacturers of Aerospace Vehicle in India-Aircraft, Space Vehicles, Main Aircraft operators in India; Aircraft Certification : Type certification, Airworthiness, CAA, FAA, DGCA, ICAO, Aircraft registration & marking of aircraft registered in India VT-AAA-ZZZ,

VT HAA-HZZ, Introduction to Aircraft Communication System : Air Band Frequencies, Navigation-GPS, Instruments, Aircraft Flight Control System, Manual, Assisted, Stability Augmentation System, Autopilot, Fly by wire.

Classification with examples : By flights regime; sub-Sonic, Supersonic, Hypersonic Flights

By wing placement; High Wing, Low Wing, Mid Wing, Cruciform (X) Wing;

By Type : Aerostatic, Aerodynamic, FW, RW, Variable sweep, Mixed fixed-Rotary, surface effect vehicles

By Planforms : Rectangular, Elliptical, Delta, Double Delta, Ogive,

By stall speed & wing span : (I-VI) combination (A-III).

System of Axes – Motion longitudinal (Roll axis), lateral (Pitch axis), vertical (Yaw axis) (x,y,z), velocity (u, v, w) and acceleration. Angles of rotation – Roll, Pitch, Yaw, Airfoil Nomenclature, Symmetric & Cambered Airfoil, Angle of Attack.

Types of Missions ; Fly by, orbiter, atmospheric, lander, penetrator, observatory, Communicator, Aerospace mission of future.

Cockpit definition parts, seats, flight deck central column rudder pedal instrument panel, pedestal panel, side console, overhead panel, glass cockpit, joystick.

2. Space Vehicles

Missile and its types, space vehicles and its types, reusable space vehicles, space shuttle ,satellites, types of satellites and their functions

PART-B

3. Airplane Propulsion

Requirement of power to fly, balance of forces, various means of producing power for forward flight., piston engines ,jet propulsion-thrust equation, turbojet, turbofan, ramjet engines. Locations of such engines, Propellor and its use. Rocket engines.

4. Airplane Structures & Materials

Structural arrangement of the Wright Flyer,. Structural details of landing gear, wing, fuselage and tail planes, functions of ribs, skin, spars, stringers, longerons. Monocoque and semi-monocoque structures,materials for main components

5. Control Systems & LEVEL FLIGHT

Various types of flaps, function of rudder, elevator, ailerons, flaprons, elevons, types of tail planes,condition for straight & level flight, flight path angle

Suggested Readings/ Books:

1 Fundamentals of Flight Richard S. Shevel , Prentice Hall
2 Introduction to flight- John D. Anderson
3 Mechanics of flight by A.C. Kermode
4 Aircraft Basic Science :Ralph D. Bent & James L. Mackinley
5 Jet Aircraft Power Sysytem : Jack V.Casamassa & Ralph D.Bent

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AE 202 AERODYNAMICS- I

PART-A

1. Introduction

Fluid statics, pascal's law,Continuum and free molecular flows, invisid and viscous flows, incompressible and compressible flows. Newtonian and Non-Newtonian flows. Pitot static tube, measurement of air-speed, pressure coefficient. Aerodynamic force and moments. Dimensional analysis, non-dimensional parameters, M, Re, Fr etc., flow similarity.

2. Description of Fluid Motion

Lagrangian and Eulerian methods, Description of properties in a moving fluid, local and material rate of change. Streamlines, Pathlines, Streaklines, Reynolds Transport theorem, Vorticity and circulation. Laws of vortex motion. Translation, rotation and rate of deformation of fluid particles.

3. Equations of Fluid Motion

Equation of conservation of mass for control volume, special form of equation of conservation of mass, differential form of equation of conservation of mass Euler's and Navier-Stoke equations. Derivation of Bernaulli's equation for invisid and viscous flow fields. Momentum equation and angular momentum equation in integral form.

PART-B

4. Invisid-Incompressible Flow

Condition on velocity for incompressible flow. Laplace's equations. Potential function, stream function. Basic elementary flows: Uniform flows, source flow, Doublet flow and Vortex flow. Superimposition of elementary flows. Non lifting and lifting flow over a circular cylinder, comparison with real flow over circular cylinder. Kutta-Jaukowski theorem, generation of lift.

5. Introduction To Viscous Flow

Qualitative aspects of viscous flows, viscosity and thermal conductivity. Phenomenon of separation. Navier-Stokes equation; Viscous flow energy equation. Some exact solutions of Navier-Stokes equations: plane Poiseuille flow , Couette flow, Hagen-Poiseuille flow and Hele-Shaw flow

6. Introduction To Incompressible Boundary Layer

BL concept, BL properties, derivation of Prandtl's BL equations, Blasius solution, Karman's Integral equation. Turbulent BL over a plate, skin friction drag, BL control.

Suggested Readings / Books:

1. Fundamentals of Aerodynamics: John D.Anderson(Jr.) 2nd Ed.McGraw Hill
2. Fluid Mechanics and its Applications: Gupta and Gupta Wiley Eastern ,1960
3. Boundary Layer Theory: H.Schlichting 6th Ed. McGraw Hill ,1986
4. Fluid Mechanics: Frank M.White 2nd Ed. McGraw Hill,1986
5. Foundations of Fluid Mechanics: S.W.Yuan Prentice Hall

ME-201 Strength of Materials – I

PART-A

1. **Simple stresses and strains** : Concept of stress and strain; St. Vernants principle, stress and strain diagram, Hooke's law, Young's modulus, Poisson ratio, stress at a point, stress and strains in bars subjected to axial loading. Modulus of elasticity, stress produced in compound bars subject to axial loading. Temperature stress and strain calculations due to applications of axial loads and variation of temperature in single and compound bars. Compound stress and strains, the two dimensional

system; stress at a point on a plane, principal stresses and principal planes; Mohr's circle of stress; ellipse of stress and their applications. Generalized Hook's Law, principal stresses related to principal strains

2. **Bending moment and shear force diagrams**: S.F and B.M definitions. BM and SF diagrams for cantilevers, simply supported beams with or without overhangs and calculation of maximum BM and SF and the point of contraflexure under the following loads:
   a) Concentrated loads
   b) Uniformity distributed loads over the whole span or part of span
   c) Combination of concentrated loads (two or three) and uniformly distributed loads
   d) Uniformity varying loads
   e) Application of moments
   Relation between rate of loading, shear force and bending moment
3. **Theory of bending stresses in beams due to bending**: assumptions in the simple bending theory, derivation of formula: its application to beams of rectangular, circular and channel, I & T-sections,: Combined direct and bending stresses in aforementioned sections, composite / flitched beams.
4. **Torsion:** Derivation of torsion equation and its assumptions. Applications of the equation to the hollow and solid circular shafts, torsional rigidity, combined torsion and bending of circular shafts principal stress and maximum shear stresses under combined loading of bending and torsion, analysis of close-coiled-helical springs.

PART-B

5. **Thin cylinders and spheres** : Derivation of formulae and calculation of hoop stress, longitudinal stress in a cylinder, effects of joints, change in diameter, length and internal volume; principal stresses in sphere and change in diameter and internal volume
6. **Columns and struts** : Columns and failure of columns : Euler's formuls; Rankine- Gordon's formula, Johnson's empirical formula for axially loaded columns and their applications.
7. **Slope and deflection** : Relationship between moment, slope and deflection, Moment area method; method of integration; Macaulay's method: Use of all these methods to calculate slope and deflection for the following :
   a) Cantilevers
   b) Simply supported beams with or without overhang
   c) Under concentrated loads, uniformly distributed loads or combination of concentrated and uniformly distributed loads

Suggested Readings/ Books:

1. Strength of Materials by Ferdinand P Singer and Andrew Pytel,Harper and Row H.
2. Kogakusha Publishers, New York
3. Mechanics of Materials by SI Version, end edition by Ferdinand P. Beer and E
4. Russel Johnston (Jr); McGraw Hill, India
5. Mechanics of Materials-SI Version 2nd Edition by EP Popov, Prentice Hall India
6. Introduction to Solid Mechanics by D.H Shames, Prentice Hall Inc.
7. Elements of strength of Materials by Timoshenko and Young
8. Strength of Materials by DS Bedi; Khanna book Publishing Company, New Delhi.
9. Strength of materials by R.S Lehri and A.S. Lehri, S.K Kataria and Sons.

ME-207 Machine Drawing

1. Principles of drawing, requirements of production drawing, sectioning and conventional representation, dimensioning, symbols of standard tolerances, machining symbols, Introduction and familiarization of the code IS:296.
2. FASTENERS : Various types of screw threads, types of nuts and bolts, screwed fasteners, welding joints and riveted joints
3. Assembly and Dis-assembly of the following manually and using computer aided drafting.

   a) Couplings: Solid or rigid Coupling, Protected type flange coupling, Pin type flexible coupling, muff coupling, Oldham, universal coupling, claw coupling, cone friction clutch, free hand sketch of single plate friction clutch.

   b) Knuckle and cotter joints

   c) Pipe and Pipe fittings: flanged joints, spigot an socket joint, union joint, hydraulic an expansion joint

   d) IC Engine Parts : Piston, connecting rod

   e) Boiler Mountings : steam stop valve, feed check valve, safety valve, blow off cock.

   f) Bearings : swivel bearing, thrust bearing, plummer block, angular plumber block

   g) Miscellaneous : Screw Jack, Drill Press Vice, Crane hook.

Drafting of simple mechanical components on computer.

NOTE :

Drawing Practice is to be done as per IS:296 code.

First angle projection to be used. Drawings should contain bill of materials and should illustrate finish. The syllabus given above indicates the broad outlines and the scope of the subject to be covered. It is not necessary to cover all the drawing exercises of the types of machine tools mentioned above.

Suggested Readings/ Books:

1. Text-book of Machine Drawing by V Lakshmi Narayanan and Mathur
2. Machine Drawing by PS Gill, BD Kataria and Sons, Ludhiana
3. Machine Drawing by ND Bhatt, Charotar publications
4. Machine Drawing by N Sidheshwar, Tata McGraw Hill

ME-211 Strength of Materials Lab

1. To perform tensile test in ductile and brittle materials and to draw stress-strain curve and to determine various mechanical properties.
2. To perform compression test on C.I. and to determine ultimate compressive strength.
3. To perform shear test on different materials and determine ultimate shear strength.
4. To perform any one hardness test (Rockwell, Brinell & Vicker's test) and determine hardness of materials.
5. To perform impact test to determine impact strength.
6. To perform torsion test and to determine various mechanical properties.
7. Study of performance of Fatigue & Creep tests
8. To perform bending test on beam (wooden or any other material) and to determine the Young's modulus and Modulus of rupture
9. To perform Torsion test and close coiled helical spring in tension and compression and to determine modulus of rigidity/stiffness
10. Determination of Bucking loads of long columns with different end conditions.

ME-214 Fluid Mechanics –I Lab

1. To determine the metacentric height of a floating vessel under loaded and unloaded conditions.
2. To study the flow through a variable area duct and verify Bernoulli's energy equation.
3. To determine the coefficient of discharge for an obstruction flow meter (venturimeter/ orifice meter)
4. To determine the discharge coefficient for a Vee- notch or rectangular notch.

5. To study the transition from laminar to turbulent flow and to ascertain the lower critical Reynolds number.
6. To determine the hydraulic coefficients for flow through an orifice.
7. To determine the friction coefficients for pipes of different diameters.
8. To determine the head loss in a pipe line due to sudden expansion/ sudden contraction/ bend.
9. To determine the velocity distribution for pipeline flow with a pitot static probe.