

Course Name: INTRODUCTION TO AERONAUTICS

Course Code: AE 210

Credits :4

L T P : 4 0 0

Lecture wise breakup

No. of Lectures

- 1 INTRODUCTION (08)**
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.
- 2 SPACE VEHICLES (07)**
Missile and its types, space vehicles and its types, reusable space vehicles, space shuttle ,satellites, types of satellites and their functions
- 3 AERODYNAMICS (10)**
Airfoil nomenclature, symmetric & cambered airfoils and their aerodynamic characteristics, angle of attack, 2-D and 3-D wing, wing as a lifting surface, types of wing planforms and their aerodynamic characteristics, centre of pressure and pressure coefficient,types of drag, lift to drag ratio as efficiency of a lifting surface, different types of flows; laminar and turbulent, effect of viscosity, concept of boundary layer, boundary layer control, high coefficient of lift devices,subsonic,transonic,supersonic and hypersonic mach no.,critical mach no., drag divergence mach no.
- 4 AIRPLANE PROPULSION (08)**
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.
- 5 AIRPLANE STRUCTURES AND MATERIALS (08)**
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
- 6 CONTROL SYSTEMS AND LEVEL FLIGHT (07)**
Various types of flaps, function of rudder, elevator, ailerons, flaps, elevons, types of tail planes,condition for straight & level flight, flight path angle

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

REFERENCES:

1. Aircraft Basic Science :Ralph D. Bent & James L. Mackinley
- 2 Jet Aircraft Power System : Jack V.Casamassa & Ralph D.Bent

AE 210H :INTRODUCTION TO AERONAUTICS :In addition to the contents of AE 210 the additional topics :

Study of Aerodynamics, structure and propulsive features of F-16, LCA, ALH Hanier and other types of military airplanes. Categorization of missiles and launch vehicles from India and abroad, uses of outer space.

Course Name : ELEMENTS OF AERODYNAMICS
Course Code :AE 211 Credits :4 Design Points: 2 L T P: 4 0 0
Lecture wise breakup No. of Lectures

- 1 Introduction (08)**
Fluid statics, pascal's law, Continuum and free molecular flows, inviscid 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 (08)**
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 (08)**
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 inviscid and viscous flow fields. Momentum equation and angular momentum equation in integral form.
- 4 Inviscid-Incompressible Flow (08)**
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 (08)**
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 (08)**
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.

Book:

1. Fundamentals of Aerodynamics : John D.Anderson(Jr.) 2nd Ed.McGraw Hill

References:

- 1 Fluid Mechanics and its Applications : Gupta and Gupta Wiley Eastern ,1960
2. Boundary Layer Theory : H.Schlichting 6th Ed. McGraw Hill ,1986
3. Fluid Mechanics : Frank M.White 2nd Ed. McGraw Hill,1986
4. Foundations of Fluid Mechanics : S.W.Yuan Prentice Hall

Additional topics for AE202H

Different Solution of N_S equations

Course Name: AIRCRAFT MATERIALS AND PROCESSES

Course Code : AE 212 Credits : 4

L T P : 4 0 0

Lecture wise breakup

No. of lectures:

- 1 INTRODUCTION (04)**
Properties of Flight Vehicle Materials, Importance of strength/weight ratio of materials for Aerospace Vehicles structures, Importance of temperature variations, factors affecting choice of material for different parts of airplane.
- 2 LIGHT METAL ALLOYS (06)**
Aluminum alloys, heat treatment, High strength and high corrosion alloys. Magnesium alloys and their properties, Heat treatment, Application of these alloys to Aerospace Vehicles.
- 3 AIRCRAFT STEELS (08)**
Classical of alloys steels, Effect of alloying elements, Carbon Steel V/S Alloys. Magnesium alloys and their properties, Heat treatment,. Application to aerospace Vehicle of these alloys.
- 4. HIGH STRENGTH AND HEAT RESISTANT ALLOYS (08)**
Classification of heat resistant materials & Iron, Nickel and cobalt base alloys, Refractory materials, Ceramics, titanium and its alloys, properties of Inconel Monal & K-Monal, Nimonic and Super Alloys; Application to Aerospace Vehicles
- 5. COMPOSITE MATERIALS (06)**
Introduction, Fibers, glass fibers, carbon fibers, Aramid fibres, Baron Fibres, Engineering ceramix. Matrix Materials – Their functions, various types , curing of resins.
- 6. METAL JOINING PROCESSES (06)**
Weldability, standard welding practices e.g. gas welding, resistance welding. Welding of light alloys, Riveting.
- 7. JIGS AND FIXTURES FOR AIRCRAFT (05)**
General design, Method of Location of cylindrical and flat surface. Design principles of wing Jig, Fuselage jig and other components.
- 8. AIRCRAFT MANUFACTURING PROCESSES (05)**
Profiling, Hydroforming, manforming bending rolls, Sparmilling, spark erosion and powered metal parts. Integral machining, Contour etching. High energy rate forming. Manufacture of honeycomb structures, General methods of construction of aircraft and aero engine parts.

BOOKS

1. Workshop technology WAJ Chapman, Vol. I,II,III
2. Aircraft Material and Processes G F Titterton, Himalayan Books, New Delhi.
3. Aircraft Production methods G B Ashmead
4. Advanced Composite materials Lalit Gupta-Himalayan Books, New Delhi, 19

Course Name : FLUID MECHANICS
Course Code : ENN 202 **Credit :** 4 **LTP:** 4 0 0
Prerequisites: Nil
Lecture wise breakup **No. of Lectures**

INTRODUCTION: **(6)**
 Fluids, definition of fluids, the science of fluid mechanics, fluid properties, viscosity, capillarity, Surface tension, compressibility, normal and shear stresses in fluid flows, Regimes of flow.

FLUID STATICS **(6)**
 Types of forces on a fluid system, Pascal's Law of measurement of pressure , manometers and gauges, numerical problems, forces on partially and fully submerged bodies including that on curved surfaces, numerical problems, Buoyancy, stability of floating bodies, centre of gravity, Meta centric heights.

DESCRIPTION AND ANALYSIS OF FLUID MOTION (Kinematics of fluid flow) **(6)**
 Lagrangian and Eulerian methods, description of properties in a moving fluid, local material rate of change , graphical description ; Streamlines, Path lines, Streak lines, Laplace equation, Stream function, velocity potential , flownet.

CONSERVATION OF MASS AND MOMENTUM **(4)**
 Equation of conservation of mass, special forms for mass conservation equation, differential form of continuity equation. External forces, linear momentum and angular momentum, momentum theorem, moment of momentum theorem.

EQUATION OF FLUID MOTION AND ENERGY EQUATION **(4)**
 Equation of motion , stress at a point, rate of deformation of a fluid element, stress in Newtonian fluids, equation of motion for incompressible flows, Euler's equation of motion, Bernoulli's equation , simple application to one dimensional flow.

FLOW THROUGH PIPES **(4)**
 Introduction, energy and hydraulics grade line, non-dimensional formulation of the pipe flow problem, head losses in pipes & pipe fittings, pipe in series & parallel , reservoir problem.

INTRODUCTION TO VISCOUS FLOWS: **(6)**
 Pressure gradient in steady uniform flow, flow between parallel plates, Qualitative aspects of viscous flows, Navier Stokes equation, (w/o derivation), : Plane poiseuille flow, couette flow, Hagen-Poiseuille's flow, Transition from laminar to turbulent flow, turbulent flow in circular pipe.

DIMENSIONAL ANALYSIS AND SIMILITUDE **(6)**

Buckingham's Theorem, non-dimensional groups, Geometric, Kinematics and Dynamic similarity, Applications.

FLOW MEASUREMENT (8)

Venturimeter, orifice meter, Pitot tube, Orifices, mouth pieces, notches, weirs, Current meter.

BOOKS:-

1. Gupta and Gupta, : " Fluid Mechanics and its Applications" , Wiley- Eastern , 1982.
2. R.J. Grade and A.G. Mirajgaonkar, Engineering Fluid Mechanics' Nem Chand and Bros. Roorkee , 1980.

REFERENCES:

1. Frank M. White," Fluid Mechanics" , McGraw Hill.
2. Modi and Seth "Hydraulic & Fluid Mechanics, Standard book house, New Delhi 1980.
3. Streeter, V. L., "Fluid Mechanics" MacGraw Hill Co.
4. Lewitt, E.H., "Hydraulics and the Mechanics of Fluids" Pitman.

Course Name : SOLID MECHANICS
Course Code : ENN 201 Credit : 4 LTP : 4 0 0

Prerequisites:

Lecture wise breakup No. of Lectures

PROPERTIES OF MATERIAL: (03)

Introduction, uni-axial tension test, idealized stress- strain diagrams, isotropic linear elastic, visco-elastic and plastic materials, compression test, impact test, fatigue test, torsion and bending test.

SIMPLE STRESSES & STRAINS: (08)

Concept of stresses and strains, relationship between elastic constants, extension of uniform bar & tapered bar under its own weight and due to load applied, stresses produced in compound bars due to axial to loads, thermal stresses, resultant stress and strain circle, principal stresses determined from principal strain.

SHEAR FORCE AND BENDING MOMENT IN BEAMS (07)

Shear force, bending moment, Relation between W.F and SF and B.M. diagram of various beams under various types of loading.

BENDING AND SHEAR STRESSES IN BAEMS (08)

Pure bending ,bending stresses, eccentric loading combined bending and direct stresses , Middle Third and middle quarter rule, composite beams, Variation of shear stresses in various cross-sectional beams.

ANALYSIS OF PLANE FRAMES

(06)

Analysis of simple plane frames, frames of different types, force analysis of plane frames by method of joints and section.

TORSION

(05)

Torsion equation for circular shaft , shafts under action of varying torque, determination of principal stresses and maximum shear stresses in circular shaft due to combined bending and torsion, torsion of composite shafts.

COLUMNS & STRUTS

(06)

Definitions and examples of instability ;criteria for stability of equilibrium ,Euler's theory of buckling of columns, Euler's equation for various end restraints, Rankine formula, eccentrically loaded struts, struts with initial curvature, lateral stability of beams ; struts with lateral loading.

DEFLECTION OF BEAMS

(07)

Deflection by calculus, Maculay's methods, Moment area method, method of deflection coefficient, deflection due to shear of various beams under the action of various loading conditions; built in and propped beams.

BOOKS:

1. An introduction to the Mechanics of Solids-Crandall & Dahi (McGraw Hill)

REFERENCES;

1. Strength of Materials-GH Ryder (MacMillan)
2. Mechanics of Solids-E.P. Popav (Pearson Education)
3. Mechanics of Materials by E.J. Hearn

Course Name : CHEMISTRY

Course Code No : CH-201

Credits: 4 L T P : 4 0 0

Lecture wise breakup

No. of Lectures

1. TREATMENT AND ITS ANALYSIS

Boiler feed water and its problems, Water Softening techniques- Internal and external treatment, Domestic Water treatment, Chemical Analysis- Hardness, Alkalinity, Dissolved Oxygen, BOD, COD, Free Chlorine, Sulphates, Chloride ions , Dissolved CO₂, TDS, TSS, SS and related numerical problems

[12]

2. CHEMICAL TOXICOLOGY

Biochemical effects of As, Pb, Cd, Hg, CN.

[4]

3. POLYMER CHEMISTRY

- Classification and stereo chemistry of polymers, Mechanism and methods of polymerisation, Structure-property relationship, Engineering Polymers- silicones, Epoxy resins and conducting Polymers, [7]
4. **ALIPHATIC AROMATIC SUBSTITUTION REACTIONS**
Electrophilic aromatic substitutions, Nucleophilic aromatic substitution- Diazonium ions, addition-elimination: Elimination viz benzyne formation. [7]
 5. **PHASE RULE**
Introduction, Gibbs phase rule and its related terms, One component system- Water system, Carbondioxide and Sulphur system. Two component system-Lead- Silver system and their thermal analysis. [6]
 6. **TRANSITION METAL COMPLEXES**
Crystal field theory and Crystal field splitting in Octahedral, tetrahedral and Square planar complexes. [5]
 7. **LUBRICANTS**
Functions of lubricant, mechanism, classification, properties and analysis of Lubricants and related numerical problems. [5]
 8. **MOLECULAR SPECTROSCOPY**
IR, UV and NMR Spectroscopy- Principle, instrumentation and applications. [9]

Text Books:

1. A Textbook of Engineering Chemistry by Shashi Chawla, Dhanpat Rai & Co.Pvt. Ltd.

Reference Books:

1. Organic Chemistry by Robert Thornton Morrison and Robert Neilson Boyd, 6th Edition 1992, Prentice Hall of India Pvt. Ltd.
2. Concise Inorganic Chemistry Vth Edition J D Lee 2003 (Chapman & Hall).
3. Introductory Polymer Chemistry by G.S.Mishra, John Wiley & Sons, New York, 1993.
4. Environmental Chemistry by A.K.De; New Age International(P) Limited, 2006
5. Modern Approach to Organic Chemistry B.Sc. Part- III Modern Publishers,2005

CH 201H ADDITIONAL TOPICS FOR HONOURS

Effluent treatment methods, Biochemical effects of cyanide and pesticides, Plastics,rubbers,fibers moulding methods for M.Wt Determination, Applications of Substitution reactions in Industrially important compounds, Organometallic compounds and their applications, Structure determination by I.R., U.V. AND NMR Spectroscopy.

Course Name : CHEMISTRY LAB.

Course Code No : CH-202 Credits : 2 L T P : 0 0 3

COURSE CONTENTS:

Volumetric analysis- Permanganometric titrations, Acid-Base titrations, Iodometric titrations, Complexometric titrations and Dichrometric titrations, __Analysis of lubricants- Viscosity, Flash Point, , Instrumental techniques for chemical analysis –

Conductometric and potentiometric titrations, Atomic Absorption Spectrophotometer, UV-Visible Spectrophotometric, Construction of phase diagram, Preparation of few inorganic complexes, organic compounds and polymers.

REFERENCE BOOKS

1. Vogel's Textbook of Quantitative Chemical Analysis, 6th Edition by J Mendham, R.C.Denny, J.D.Barnes and MJK Thomas, Pearson Education.
2. Vogel's Qualitative Inorganic Analysis, 7th Edition by G.Svehla, Pearson Education.
3. Essentials of Experimental Engineering Chemistry by Shashi Chawla, Dhanpat Rai & Co. (PVT.) LTD. New Delhi.
4. Applied Chemistry Theory and Practice by O.P.Vermani and A.K.Narula, New Age International (P) Limited Publishers, New Delhi.