

BASIC AERODYNAMICS

DETAILED SYLLABUS

Objectives

It aims at enabling the student to understand basic concepts of aerodynamics.

UNIT- I THE ATMOSPHER

The atmosphere Relevance to Aerodynamics, Introduction to the atmosphere, various layers of Atmosphere, Explanation of various layers of atmosphere with respect to variation of temperature, Pressure and density with change in altitude Explanation of the diagram showing variation of temperature, pressure, density, relative Humidity and viscosity of air with change in altitude, Physical properties of air Fluid pressure, Composition of air: Explanation of constituents of air using tabular Standard Atmosphere: Explanation of standard atmosphere, International Standard Atmosphere (ISA), Temperature :Pressure .

UNIT- II BEHAVIOUR OF AIR

Speed of sound ,Bernoulli's Equation and Equation of continuity, Dynamic pressure ,static pressure, total pressure, Explanation of total pressure in terms of dynamic and static pressure, Air Speed and Ground Speed, Methods of measuring Air speed Pitot static tube: General features, Types of Pitot tubes in use, location, AIR SPEED TERMINOLOGY: Indicated air speed(IAS), Calibrated Air Speed (CAS), Equivalent Air Speed (EAS), True Air Speed (TAS),The venturi tube: variation of pressure ,speed, across venturi tube

UNT- III THEORY OF LIFT

The circulation theory of lift Flow of Air past a circular cylinder Flow past a two dimensional Aerofoil, Explanation of Air flow about an aerofoil with different amounts of Circulation imposed-diagrams, Vortex Flow-Formation of Vortex, Magnus Effect and the wake behind the aerofoil Boundary Layer- Definition of boundary layer, laminar and turbulent boundary layers, boundary layer characteristics, Effect of Reynolds number on boundary layer, CRITICAL REYNOLD'S number , Scale effect Simple problem based on above topic

UNIT- IV LOW SPEED AEROFOIL

Introduction and general requirements of aerofoil, Aerofoil terminology, explanation of a typical aerofoil with diagram, Forces acting on an aerofoil- Explanation with diagram, Types of Aero foils, Different aerofoil sections- diagrams, Centre of pressure (CP), Aerodynamic centre,

pitching moment, Finite wing terminology, Aspect ratio Factors affecting the performance of the aerofoil -RAF 15, Clark Y, NACA-4 digit and digit series, Pressure distribution around an aerofoil, Sweep back wings, Effect of sweep back on stalling, Drag, components of total drag-zero lift drag, lift dependant drag-- stalling effects Simple problem based on above topic

UNIT- V HIGH LIFT DEVICE

Introduction to high lift devices, Flaps, purpose of flaps, action of the flaps, effect of flaps and slats on lift, Types of flap- plain/camber, split, tap, slotted, double slotted, Fowler, Principle of operation of SLATS, automatic Slots, use of slots

UNIT- VI HIGH SPEED AERODYNAMICS

Introduction: Effect of various speeds on coefficient of lift, Compressive Lift Vortex lift, Effect of vortices on Coefficient of lift, Effect of compressibility on Drag Transonic and supersonic Aerodynamic, Mach waves, Large pressure waves, Shock waves- Formation of bow shock wave, Wing surface Shockwaves, Conditions for shock wave generation, Bottom surface, Top shockwave, Nature of shockwave-physical effects of a shockwave, Normal shock wave, Oblique shockwave, Shock stall and Sonic Boom

TEXT BOOKS

1. Wg Cdr(Retd) DP Sabharwal Basic Aerodynamics.
2. Lalit Gupta & Dr O.P Sharma Fundamental of flight (Basic Aerodynamics)

REFERENCES

1. Anderson, J.D., "Introduction to Flight", McGraw-Hill, 1995
2. Kermode, A.C., "Flight without Formulae", McGraw-Hill, 1997
3. Kermode, A.C., "Mechanics of Flight".