

AS6: AIRPLANE PERFORMANCE, STABILITY AND CONTROL

Atmosphere : ISA, Geopotential and Geometric altitude, Troposphere and Stratosphere, stability of atmosphere.

Aerodynamic characteristics : Drag Aerodynamics, Drag polar, estimation of drag. Forces and moments from dimensional analysis, pressure distribution over airfoils, variation with angle of attack, aerodynamic centre, centre of pressure - related problems. Estimation of CL, CD and CM from pressure distribution, variation of aerodynamic coefficients with Reynolds number and Mach number. Effect of span, aspect ratio, planform, sweep, taper and twist on aerodynamic characteristics. High lift devices. V/STOL configurations.

Airplane Performance in Steady and Level Flight : Equations of motion of aircraft, variation of drag with flight, power required and power available, minimum drag and minimum power conditions, climbing and gliding performance.

Airplane Performance in Accelerated Flight : Take off and landing distances, Jet Assisted Take off, Range and Endurance. Turning flight performance.

Static longitudinal stability : Stick fixed static longitudinal stability, neutral point, power effects, stick free static longitudinal stability. Hinge moments, Aerodynamic Balancing, Static Margin. In flight measurement of stick fixed and stick free neutral points.

Maneuvering flight : Elevator angle per g and stick force per g maneuver margin.

Lateral and Directional Stability and Control: Asymmetric flight, weathercock stability, Rudder fixed and Rudder free static directional stability - Rudder lock, dihedral effect. Control in Roll, Aileron control power. Cross coupling of lateral and directional effects. Numerical problems.

Dynamic Stability : Equations of motion of airplane, stability derivatives, split-up of equations in symmetrical and non-symmetric groups of motion.

Analysis of short period and phugoid mode

Analysis of roll and spiral modes, Dutch Roll.

Text Books:

1. John D Anderson Jr., Introduction to Flight, McGraw Hill
2. R C Nelson, Flight Stability & Automation Control, McGraw Hill

Reference Books:

1. B Etkins, Dynamics of Flight, John Wiley
2. E L Houghton and N B Caruthers, Aerodynamics for Engineers, Edward Arnold, UK