

ASE204:AERODYNAMICS-II

L:3 T:0 P:0 Credits:3

Course Outcomes: Through this course students should be able to

- CO1 :: familiar the concepts of compressible fluid flow
- CO2 :: Apply knowledge of normal and oblique shock and expansion wave formation.
- CO3 :: determining the properties of various flow properties in a constant area duct
- CO4 :: examine the various rules governing numerical method of characteristics
- CO5 :: analyze the concept of superposition of elementary flows for Non linear compressible flow
- CO6 :: illustrate the boundary layer interaction at high speed flow over airfoils and wings

Unit I

Concepts of compressible flow : Introduction to isentropic flow-Scope of compressible flow, Energy and momentum equations for compressible fluid flow, reference velocities-stagnation states, velocity of sound-critical states-mach number-critical mach number, Types of waves- mach cones - Mach angle-effect of Mach number on compressibility flow regimes

Unit II

Shocks and its applications : Development of normal shocks-governing equations, Hugoniot equation, Stationary and moving normal shock waves-applications, Oblique shock- Reflection of flow, Interaction of oblique shock waves, slip line, shock boundary layer Interaction

Unit III

Expansion waves and flow over nozzles : Prandtl-Meyer expansion flow and related problems, Under and over expanded nozzles, maximum turning angle, Simple and non-simple regions

Unit IV

Flow in constant area duct : Fanno flow- fanno flow equations and solutions, variation of flow properties variation of Mach number with duct length, tables and charts for fanno flow, Rayleigh line, Rayleigh flow equations-variation of flow properties, tables and charts for Rayleigh flow

Unit V

Brief introduction to the methods of characteristics : Method of characteristics -Prandtl-Glauert and Goethert rules, Ackeret's supersonic airfoil theory, Small perturbation equations for subsonic, transonic, supersonic and hypersonic flow, Experimental characteristics of airfoils incompressible flow

Unit VI

High speed flow over airfoils,wings : Shock stall, Supercritical Airfoil Selections, Lift, drag,pitching moment and centre of pressure for supersonic profiles, Transonic area rule, Airfoil for supersonic flows, shock expansion theory, Supersonic wings, Design considerations for supersonic aircraft-aerodynamic heating

Text Books:

1. GAS DYNAMICS by RADHAKRISHNAN, E, PRENTICE HALL

References:

1. FUNDAMENTALS OF COMPRESSIBLE FLOW WITH AIRCRAFT AND ROCKET PROPULSION by S M YAHYA, NEW AGE INTERNATIONAL
2. THE DYNAMICS AND THERMODYNAMICS OF COMPRESSIBLE FLUID FLOW by SHAPIRO, A.H, JOHN WILEY & SONS
3. FUNDAMENTALS OF AERODYNAMICS by J D ANDERSON, MC GRAW HILL

