Aerodynamics- II

Important 13mark questions

Unit I

1. Obtain the mass flow relation in terms of Mach number.
2. Obtain the expression which relates the change in pressure, temperature, density and velocity in terms of Mach number for a one-dimensional flow in a variable duct. And discuss how the above properties varying with subsonic and supersonic Mach number in convergent and divergent passage.

Unit II

1. What is meant by mass-motion velocity? And show that the mass- motion velocity depends on the pressure ratio across the shock wave and the speed of sound ahead of the wave.
2. Show that the wave velocity of moving shock depends on the pressure ratio across the wave and the speed of sound of the gas which the wave is propagating. And prove that the induced velocity of stagnant air due to moving shock also the same dependence.

Unit III

1. Derive the expression for the velocity potential equation. And state the assumption made.
2. Explain the design procedure of convergent-divergent nozzle using the method of characteristics.

Unit IV

1. Explain the detail about the uses of super critical airfoil in drag reduction.
2. Using shock expansion theory, calculate the lift and drag coefficients of a symmetrical diamond airfoil of semiangle $\theta = 10^0$ at an angle of attack to the free stream of 12^0 when upstream Mach number and pressure are 3.0 and 100 kPa.

Unit V

1. What are the peculiar observed problems in the operation of hypersonic tunnels?
2. With neat sketch explain the working principle of Helium based hypersonic wind tunnel.