AE 624

TUTORIAL – 1

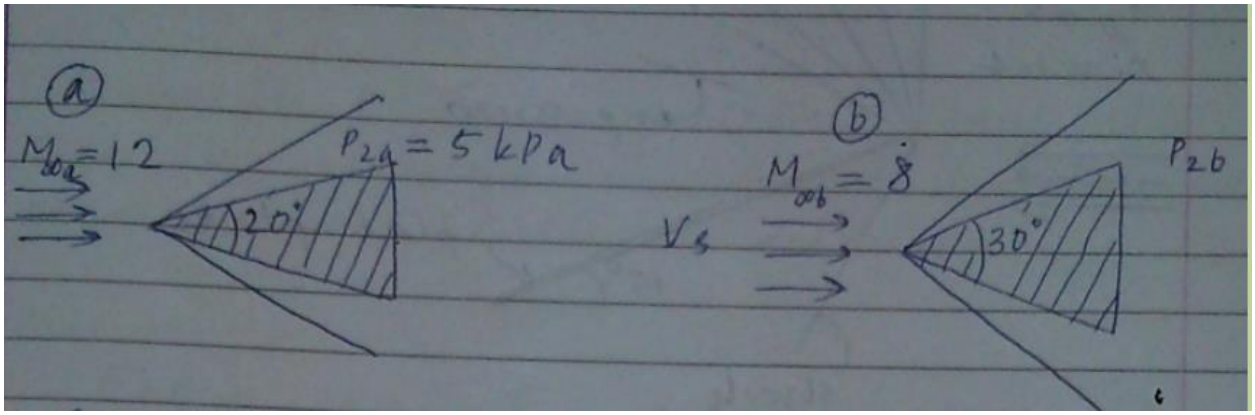
Hypersonic Shock Relation

1. Air is expanded from a large reservoir in which the pressure and temperature are 1 MPa and 35^0 C through the variable area duct. A normal shock occurs at a point in the duct where the Mach number is 8. Find the pressure and temperature in the flow just downstream of the shock wave. Downstream of the shock wave, the flow is brought to rest in another large reservoir. Find the pressure and temperature in the reservoir. Assume that the flow is one-dimensional and isentropic everywhere except through the shock wave.

2. Air flows over a blunt nosed body. The air flow in the freestream, ahead of the body has a Mach number of 9 and static pressure of 100 Pa. Find the pressure acting on the front of the body using hypersonic relation and compare it with the solution from exact normal shock relation. Sketch the flow pattern near the nose.

3. Air is flowing over a flat wall. The pressure and temperature in the air-stream are 200 Pa, and -50^0 C respectively. If the wall turns through an angle of 30^0 leading to the formation of an oblique shock wave, find the percentage difference in calculating the pressure, density and temperature in the flow behind the shock wave using both exact supersonic relations and hypersonic relations(M tends to infinity) for Mach (i)8 (ii)12.

4. Calculate P_{2b}, if $\rho_{\infty b} = \rho_{\infty a}/2$ and $T_{\infty a}=T_{\infty b}$.



5. Air flowing with a Mach number of 7 with a pressure of 120 Pa and a temperature of -60^0 C passes over a wedge which turns the flow through an angle of 4^0 leading to the generation of an oblique shock wave. This oblique shock wave impinges on a flat wall, which is parallel to the flow upstream of the wedge and is reflected from it. Find the pressure, Mach and velocity behind the reflected shock wave.