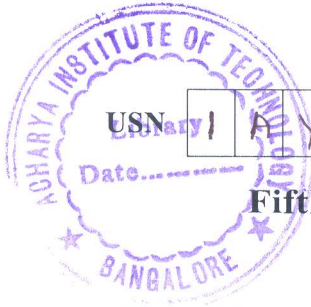


CBCS SCHEME

18AE/AS52



Fifth Semester B.E. Degree Examination, July/August 2021 Aerodynamics – II

Time: 3 hrs.

Max. Marks:100

**Note: 1. Answer any FIVE full questions.
2. Use of Gas table is permitted.**

- 1 a. Define
- Critical velocity of sound
 - Crocco number
 - Maximum fluid velocity
 - Isentropic process
 - Flow process. (10 Marks)
- b. The pressure, temperature and Mach number at the entry of a flow passage are 2.45 bar, 26.5°C and 1.4 respectively. If the exit Mach number is 2.5. Determine for adiabatic flow of a perfect gas ($\gamma = 1.3$, $R = 0.469 \text{ kJ/kg-k}$):
- Stagnation temperature
 - Temperature and velocity of gas at exit
 - The flow rate per square meter of the inlet cross-section. (10 Marks)
- 2 a. Explain De-Laval nozzle. Derive an expression for area ratio as a function of Mach number. (10 Marks)
- b. A conical diffuser has entry and exit diameters of 15cm and 30cm respectively. The pressure, temperature and velocity of air at entry are 0.69bar, 340K and 180m/s respectively. Determine:
- The exit pressure
 - The exit velocity
 - The force exerted on the diffuser walls. Assume isentropic flow, $\gamma = 1.4$, $C_p = 1.00 \text{ kJ/kg-K}$. (10 Marks)
- 3 a. Derive the expression for Mach number downstream of the normal shock wave. (10 Marks)
- b. The ratio of the exit to entry area in a subsonic diffuser is 4.0. The Mach number of a jet of air approaching the diffuser at $P_0 = 1.013 \text{ bar}$, $T = 290\text{K}$ is 2.2. There is a standing normal shock wave just outside the diffuser entry. The flow in the diffuser is isentropic. Determine at the exit of the diffuser
- Mach number
 - Temperature
 - Pressure. (10 Marks)
- 4 a. Explain about moving normal shock waves. (10 Marks)
- b. The velocity of a normal shock wave moving into stagnant air ($P = 1.0 \text{ bar}$, $t = 17^\circ\text{C}$) is 500 m/s. If the area of cross – section of the duct is constant determine:
- Pressure
 - Temperature
 - Velocity of air
 - Stagnation temperature
 - The Mach number imported upstream of the wave – front. (10 Marks)

- 5 a. Derive a relation connecting flow turning angle, shock angle and free stream Mach number for oblique shock waves. (10 Marks)
- b. Air approaches a symmetrical wedge ($\delta = 15^\circ$) at a Mach number of 2.0. Determine for the strong and weak waves :
- Wave angle
 - Pressure ratio
 - Density ratio
 - Temperature ratio. (10 Marks)
- 6 a. Write the Prandtl – Meyer equation for oblique shock wave. (10 Marks)
- b. Derive Rankine – Hugonit equation for oblique shock. (10 Marks)
- 7 a. Explain small perturbation theory and also derive linearized potential flow equation for compressible flow. (10 Marks)
- b. Explain boundary conditions for cambered airfoil of an angle of attack. (10 Marks)
- 8 a. Derive an expression for linearized pressure co-efficient. (10 Marks)
- b. Explain Prandtl – Glauert rule for a two dimensional subsonic flow. (10 Marks)
- 9 a. With the help of a neat sketch, explain closed circuit supersonic tunnel. (10 Marks)
- b. Explain the following with suitable sketch :
- Mach – Zhender interferometer
 - Hot – wire anemometer. (10 Marks)
- 10 a. Explain the pressure measuring instruments used in wind tunnel. (10 Marks)
- b. Write short notes on Schlieren technique and Gun tunnels. (10 Marks)
