CBCS SCHEME

USN | | | | | | | | | | | **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
- i) Critical velocity of sound
- ii) Crocco number
- iii) Maximum fluid velocity
- iv) Isentropic process
- v) 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 f a perfect gas ($\gamma = 1.3$, R – 0.469kJ/kg-k) :
- i) Stagnation temperature
- ii) Temperature and velocity of gas at exit
- iii) 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 :
- i) The exit pressure
- ii) The exit velocity
- iii) The force exerted on the diffuser walls. Assume isentropic flow, $\gamma = 1.4$, $C_p = 1.00$ 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 $P_0 = 1.013$ bar, T = 290K is 2.2. These 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
- i) Mach number
- ii) Temperature
- iii) Pressure. **(10 Marks)**

4 a. Explain about moving normal stock waves. **(10 Marks)**

b. The velocity of a normal shock wave moving into stagnant air (P = 1.0 bar, t = 17°C) is 500 m/s. If the area of cross – section of the duct is constant determine :
- i) Pressure
- ii) Temperature
- iii) Velocity of air
- iv) Stagnation temperature
- v) The Mach number imported upsteam 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 ($\delta = 15°$) at a Mach number of 2.0. Determine for the strong and weak waves :
   i) Wave angle
   ii) Pressure ratio
   iii) Density ratio
   iv) Temperature ratio. **(10 Marks)**

6 a. Write the Prandtl – Meyer equation for oblique shock wave. **(10 Marks)**

b. Derive Rankine – Hugnoit 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 – Glauret 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 :
   i) Mach – Zhender interferometer
   ii) 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)**

* * * * *