



CBCS SCHEME

18AE/AS52

Fifth Semester B.E. Degree Examination, Dec.2023/Jan.2024 Aerodynamics – II

Time: 3 hrs.

Max. Marks: 100

- Note:** 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Use of Gas Tables is permitted.

Module-1

- 1 a. Write the principle of energy equation and derive the relation for energy equation in differential form. (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 ($\gamma = 1.3$, $R = 0.469$ kJ/kg-K).
(i) Stagnation temperature
(ii) Temperature and velocity of free at exit
(iii) The flow rate per square meter of the inlet cross section. (10 Marks)

OR

- 2 a. Describe the variation of pressure along the convergent-divergent duct for various back pressures with a neat sketch. (10 Marks)
b. Air ($C_p = 1.05$ kJ/kgK, $\gamma = 1.38$) at $P_1 = 3 \times 10^5$ N/m² and $T_1 = 500$ K flows with a velocity of 200 m/s in a 30 cm diameter duct. Calculate: (i) Mass flow rate (ii) Mach number (iii) Stagnation temperature (iv) Stagnation pressure values, assuming the flow an compressible and incompressible. (10 Marks)

Module-2

- 3 a. Write the equation for normal shock wave and obtain Prandtl relation for normal shock wave. (10 Marks)
b. The state of a gas ($\gamma = 1.3$, $R = 0.469$ kJ/kgK) upstream of a normal shock wave is given by the following data: $M_x = 2.5$, $P_x = 2$ bar, $T_x = 275$ K. Calculate the Mach number, pressure, temperature and velocity of the gas downstream of the shock. Check the calculated values with those given in the gas tables. (10 Marks)

OR

- 4 a. Explain about Hugoniot curve and obtain relation for Hugoniot equation. (10 Marks)
b. A gas ($\gamma = 1.4$, $R = 0.287$ kJ/kgK) at a Mach number of 1.8, $P = 0.8$ bar and $T = 373$ K passes through a normal shock. Determine its density after the shock. Compare this value in an isentropic compression through the same pressure ratio. (10 Marks)

Module-3

- 5 a. Draw an oblique shock and obtain its relation for θ - β -M relation and explain its importance. (10 Marks)
b. Write short note on supersonic compression and supersonic expansion. (10 Marks)

OR

- 6 a. Write the Prandtl-Meyer equation for oblique shock wave. (10 Marks)
b. Derive Rankine-Hugoniot equation for oblique shock. (10 Marks)

Module-4

- 7 a. Derive small perturbation theory applicable for compressible flow. (10 Marks)
b. Explain boundary conditions for cambered airfoil of an angle of attach. (10 Marks)

OR

- 8 a. Explain Prandtl-Glauret rule for a two dimensional subsonic flow. (10 Marks)
b. Derive an expression for linearized pressure coefficient. (10 Marks)

Module-5

- 9 a. Write about types of wind tunnel and explain with neat sketch. (10 Marks)
b. Explain the pressure measuring instruments used in wind tunnel. (10 Marks)

OR

- 10 a. With the help of relevant sketches, explain the various types of velocity measuring devices. (10 Marks)
b. Write short notes on shock tubes and shock tunnels. (10 Marks)
