CBCS SCHEME

USN | | | | | | | | | | |

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/m^2 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 Hugonoit curve and obtain relation for Hugonoit 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-Hugonoit 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)**

* * * * *