CBCS SCHEME

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18AE/AS52

Fifth Semester B.E. Degree Examination, Feb./Mar. 2022
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 are permitted.

Module-1

1 a. Derive an expression for Area-Mach number relation with usual notation and explain expansion and compression process. **(10 Marks)**

b. Air (CP = 1.05 kJ/kg K, $\gamma = 1.38$) at $P_1 = 3 \times 10^5 N/m^2$ and $T_1 = 500K$ flows with a velocity of 200m/s in a 30cm 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)**

OR

2 a. Describe the variation of pressure along the convergent-divergent duct for various back pressures with a neat sketch. **(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 0.69 bar, 340K and 180m/s respectively. Determine: i) The exit pressure ii) the exit velocity iii) force exerted on the diffuser walls solve using gas tables. **(10 Marks)**

Module-2

3 a. Derive Prandtl meyer relation with usual notation for a normal shock wave. **(10 Marks)**

b. The state of a gas ($\gamma = 1.3$, R = 0.469 kJ/kg K) upstream of a normal shock wave is given by the following data:
$M_x = 2.5$, $P_x = 2$ bar, $T_x = 275K$. 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. Derive an expression for downstream Mach number in a normal shock wave, with usual notations. **(10 Marks)**

b. A gas ($\gamma = 1.4$, R = 0.287kJ/kgK) at a Mach number of 1.8, P = 0.8 bar and T = 373K 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. Derive an expression for Rankine-Hugoroit equation 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 ratios
iii) Density ratio
iv) Temperature ratio
v) Downstream mach number.
Verify these values using Gas tables for normal shocks. **(10 Marks)**

OR

6 a. Derive the governing equations for Rayleigh flow with heating or cooling in ducts and explain Rayleigh line using T-S coordinate. **(10 Marks)**

b. A circular duct panes 8.25 kg/s of air at an exit Mach number of 0.5. The entry pressure and temperature are 3.45bar and 38°C respectively. And the coefficient of friction is 0.005. If the mach number at entry is 0.15. Determine:
   i) The diameter of the duct
   ii) Length of the duct
   iii) Pressure and temperature at exit
   iv) Stagnation pressure loss **(10 Marks)**

Module-4

7 a. With the help of relevant sketches derive an equation for small perturbation theory and explain. **(10 Marks)**

b. Describe Von-Karman rule for transonic flow. **(10 Marks)**

OR

8 a. Explain the various methods of solution of non-linear potential equation with relevant sketches. **(10 Marks)**

b. Derive an equation for two-dimensional linearised flow for subsonic flow or the Prandtl-Glauret transformation. **(10 Marks)**

Module-5

9 a. With the help of relevant sketches, explain the various types of pressure measuring devices. **(10 Marks)**

b. Describe the working of a closed circuit continuous type supersonic wind tunnel with the help of a schematic diagram. **(10 Marks)**

OR

10 a. With the help of relevant sketches, explain the various types of velocity measuring devices. **(10 Marks)**

b. With the help of a neat sketch explain Schlieren technique. **(10 Marks)**

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