CBCS SCHEME

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18AE/AS52

Fifth Semester B.E. Degree Examination, Dec.2024/Jan.2025
Aerodynamics – II

Time: 3 hrs. Max. Marks: 100

Note: *Answer any FIVE full questions, choosing ONE full question from each module.*

Module-1

1 a. Ambient air [p_0 = 1.013 bar, T_0 = 288 K) is sucked by a blower through a convergent nozzle [throat diameter = 10cm]. If the air velocity at the throat reaches sonic values determine :
i) Pressure and temperature at throat
ii) Mass flow rate at the throat **(10 Marks)**

b. Derive the energy equation for steady one dimensional flow. **(10 Marks)**

OR

2 a. A conical diffuse has entry and exist diameter of 15 cm and 30 cm respectively. The pressure, temperature and velocity of air at entry are 0.69 bar, 340 K and 180 m/s respectively. Find
i) the exit pressure
ii) the exit velocity. **(10 Marks)**

b. Describe the performance under various back pressures considering convergent divergent nozzle with neat relevant sketch. **(10 Marks)**

Module-2

3 a. An aircraft files at Mach Number of 1.2 at an altitude of 16,000 meters. The compression in its engine is partly achieved by a normal shock wave standing at the entry of its diffuser. Determine immediately downstream of the shock mach number, temperature and pressure. Also determine the stagnation pressure loss cross the shock. **(10 Marks)**

b. Derive the Mach number equation across a normal shock wave in term of upstream Mach Number. **(10 Marks)**

OR

4 a. Estimate the Mach Number, pressure temperature and velocity of a gas at the downstream of a shock if the gas upstream of the shock has a pressure of 2 bar at 275 K. The upstream Mach Number is 1.8. The specific heat ratio of the gas is 1.3 while R is 469 J/Kg K. **(10 Marks)**

b. Derive an expression for Rankine – Hugonoit equation for normal shocks. **(10 Marks)**

Module-3

5 a. Derive Prandtl's equation for an oblique shock wave **(10 Marks)**

b. Define hodograph and shock polar with neat sketch. **(10 Marks)**

OR

6 a. Define mach angle and Mach cone with neat sketch. **(10 Marks)**

b. The Mach number at the exit of a combustion chamber is 0.9. The ratio of stagnation temperature at exit and entry is 3.74. If the pressure and temperature of the gas at exit are 2.5 bar and 1000° C respectively, determine

i) Mach Number, pressure and temperature of the gas at entry
ii) The heat supplied per Kg of the gas
iii) The maximum heat that can be supplied.

The $\gamma = 1.3$ and $C_p = 1.218$ kJ/Kg K. **(10 Marks)**

Module-4

7 a. Derive the equation of linearized velocity potential equation. **(12 Marks)**

b. Explain Crocco's theorem. **(08 Marks)**

OR

8 a. Derive the linearized pressure coefficient valid for small perturbation. **(10 Marks)**

b. Derive the basic potential equation for compressible flow. **(10 Marks)**

Module-5

9 a. Explain blow down type with neat sketch. **(10 Marks)**

b. Explain the working of schlieren system with neat sketch. **(10 Marks)**

OR

10 a. Explain the various methods adopted for flow visualization in subsonic flow. **(10 Marks)**

b. Illustrate the working mechanism of shock tunnel. **(10 Marks)**

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