

15AE61

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

Time: 3 hrs.

Max. Marks: 80

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

Module-1

- a. Derive the total energy equation for steady 1-D flow for a control volume. (08 Marks)
  - b. Draw a neat sketch showing the variation of pressure along the convergent divergent duct for various back pressures and explain. (08 Marks)

OF

- 2 a. Briefly explain the significance of speed of sound. Also derive the expression for the same.
  - b. Air ( $C_P = 1.05$  KJ/kg-K,  $\gamma = 1.38$ ) at  $P_1 = 3 \times 10^5$  N/m<sup>2</sup> and  $T_1 = 500$  K, flows with velocity of 200 m/s in a 30 cm diameter duct. Calculate :
    - i) Mass flow rate
    - ii) Mach number
    - iii) Stagnation temperature.

(08 Marks)

Module-2

- 3 a. Derive the mach number equation across a normal shock wave in terms of upstream mach number.

  (08 Marks)
  - b. Describe in detail about moving normal shock waves with a neat sketch and appropriate equations.

    (08 Marks)

OR

a. 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 duct is constant determine: i) Pressure ii) Temperature iii) Velocity of air iv) Stagnation temperature and v) The Mach number imported upstream of the wave-front.

Note: At  $M_x = 1.465$ ,  $M_y = 0.715$ 

 $P_y/P_x = 2.335$ ,  $T_y/T_x = 1.297$ 

(08 Marks)

b. Derive Rankine-Hugnoit equation for normal shock waves and compare the same for isentropic flow.

(08 Marks)

Module-3

5 a. Derive Prandtl-Equation for the oblique shocks.

(08 Marks)

b. Explain in detail about the shock polar with a neat graphs.

(08 Marks)

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OR

6 a. Derive an expressions for Rankine Hugonoit equation for oblique shocks.
b. With a neat graphs, explain the pressure turning angle in detail. (06 Marks)

Module-4

7 a. Derive the basic potential equation for compressible flow.
b. Explain the different boundary conditions used for the flow over an airfoil.
(06 Marks)

OR

8 a. Briefly explain the Von-Karman rule for transonic flow. (08 Marks)

b. A profile has at  $M_{\infty} = 0.29$ , the following lift co-efficients:

 $C_L = 0.2$  at  $\alpha = 3^\circ$  $C_L = -0.1$  at  $\alpha = -2^\circ$ 

Calculate  $\frac{dC_L}{d\alpha}$  for M = 0.2, 0.4 and 1

(08 Marks)

**Module-5** 

9 a. What are various types of Wind tunnels?

(08 Marks)

b. Explain various pressure measuring instruments.

(08 Marks)

OR

What are various Flow visualization techniques? (16 Marks)

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