

CBCS SCHEME

15AE61

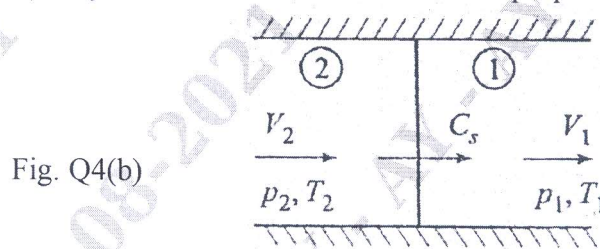
Sixth Semester B.E. Degree Examination, July/August 2021 Aerodynamics - II

Time: 3 hrs.

Max. Marks: 80

Note: Answer any FIVE full questions.

- 1 a. Write Integral form of Momentum and Energy equations. (06 Marks)
b. Derive Compressible form by Bernoulli's equation for inviscid flows. (04 Marks)
c. A storage chamber is maintained at 1.8 atmosphere absolute and 20°C. The surrounding ambient pressure is 1 atmosphere. Calculate
i) the velocity with which airflow will take place from the chamber to the outside through a unit area hole
ii) the mass flow rate per unit area.
Assume air as perfect gas. (06 Marks)
- 2 a. Derive expression for V_{\max} for discharge from a reservoir through a small opening and show that $V_{\max(\text{comp})} = 1.9 V_{\max(\text{incomp})}$. (08 Marks)
b. Derive expression for mass flow per unit area for flow from a reservoir in terms of Mach number. (08 Marks)
- 3 a. Derive the expression for stagnation pressure ratio across a normal shock wave. (07 Marks)
b. Draw graphical representation of flow properties behind a normal shock wave as a function of upstream Mach number. (09 Marks)
- 4 a. Derive expression for Hugoniot equation for moving shock wave. (07 Marks)
b. A normal shock wave moves in a constant area tube as shown in Fig. Q4(b) below. In the region '1', $V_1 = 100\text{m/sec}$, $T_1 = 30^\circ\text{C}$ and $p_1 = 0.7\text{atma}$. The shock speed C_s with respect to fixed coordinate system is 600m/sec. Find the fluid properties in region '2'. (09 Marks)



- 5 a. What is Shock Polar and Sonic Circle? Draw dimensionless shock polar. (06 Marks)
b. Derive Relation $\theta - \beta - M$ i.e Flow deflection angle, Oblique shock angle, Mach number and show it as a plot. (10 Marks)
- 6 a. Derive the differential Mach equations and explain the effect of friction on flow properties at Subsonic and Supersonic Mach numbers. (12 Marks)
b. In subsonic flow when heat is added, prove that temperature increases for $M_1 < \gamma^{-1/2}$ and decreases for $M_1 > \gamma^{-1/2}$. (04 Marks)

- 7 a. Derive the compressible flow full potential equation in the following form.
$$\left(1 - \frac{u^2}{a^2}\right) \frac{\partial^2 \phi}{\partial x^2} - \frac{2uv}{a^2} \frac{\partial^2 \phi}{\partial x \partial y} + \left(1 - \frac{v^2}{a^2}\right) \frac{\partial^2 \phi}{\partial y^2} = 0.$$
 (10 Marks)
- b. Explain the Prandtl – Glauert rule for subsonic and supersonic flow. (06 Marks)
- 8 Explain the method of Characteristics. (16 Marks)
- 9 a. What are various types of Wind tunnels? (08 Marks)
b. Explain various pressure measuring instruments. (08 Marks)
- 10 What are various Flow visualization techniques? (16 Marks)
