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B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

February / March 2023 Semester End Main Examinations

Programme: B.E. **Semester: V**
Branch: Aerospace Engineering **Duration: 3 hrs.**
Course Code: 20AE5DCAAD **Max Marks: 100**
Course: Advanced Aerodynamics **Date: 27.02.2023**

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.
3. Use of Gas Tables is permitted

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

UNIT - I

1 a) Derive the expression of momentum equations for compressible fluid flow. **10**

b) Derive the expression of Area-Mach number relation. **10**

OR

2 a) Derive the expression of velocity of sound. **10**

b) Discuss the effect of Mach number on compressibility flow regimes. **10**

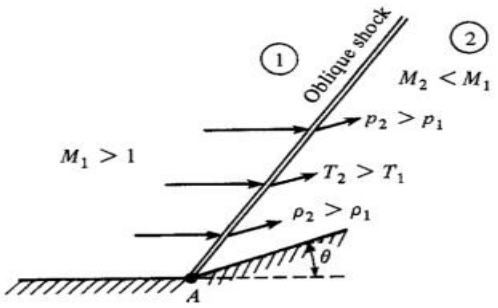
UNIT – II

3 a) Air flows adiabatically in a pipe. A normal shock wave is formed. The pressure and temperature of air before and after the shock are 150 kN/m^2 and 25°C respectively. The pressure just after the normal shock is 350 kN/m^2. Calculate **10**
(i) the Mach number before the shock,
(ii) Mach number, static temperature and velocity of air after the shock wave.
(iii) Increase in density of air,
(iv) Loss of stagnation pressure of air,
(v) Change in entropy.

b) An airstream (γ = 1.4 and R = 287 J/kg-K) with a velocity of 500 m/s a static pressure of 50 kPa and a static temperature of 250 K undergo a normal shock. Determine the air velocity and the static and stagnation conditions after the wave. **10**

OR

4 a) A uniform supersonic stream with $M_1 = 3.0$, $p_1 = 1$atm, and $T_1 = 288$ K encounters a compression corner which deflects the stream by an angle $\theta = 2.0$. Calculate the shock wave angle, and p_2, T_2, M_2, p_{o2}, and T_{o2}, behind the shock wave. **10**



b) Discuss about the nature of flow through oblique shock waves. **10**

UNIT – III

5 a) Explain about Pandtl-Meyer expansion waves **10**

b) Discuss about the flow over under expanded and over expanded nozzles with neat sketch. **10**

UNIT – IV

6 a) Discuss about the variations of flow properties in Rayleigh flow. **08**

b) A circular duct passes 8.25 kg/s of air at exit Mach number of 0.5. The entry pressure and temperature are 3.45 bar and 38℃ respectively and the coefficient of friction 0.005. If the Mach number at entry is 0.2, determine (a) the diameter of the duct (b) length of the duct (c) pressure and temperature at the exit (d) stagnation pressure loss **12**

UNIT - V

7 a) Explain in detail the Prandtl-Glauert similarity rule for two dimensional supersonic flow with three versions. **10**

b) The theoretical lift coefficient for a thin symmetric airfoil in an incompressible flow is $C_l = 2\pi\boldsymbol{\alpha}$. Calculate the lift coefficient for M=0.7. **10**

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