CBCS Scheme

USN | | | | | | | | | | |

15AE61

# Sixth Semester B.E. Degree Examination, June/July 2018
## Aerodynamics – II

Time: 3 hrs. Max. Marks: 80

**Note:** 1. *Answer any FIVE full questions, choosing one full question from each module.*
2. *Use of Gas tables is permitted.*





### Module-1

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)**

**OR**

2 a. Briefly explain the significance of speed of sound. Also derive the expression for the same. **(08 Marks)**

b. Air ($C_P$ = 1.05 KJ/kg-K, $\gamma$ = 1.38) at $P_1 = 3 \times 10^5$ N/m$^2$ 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 expression for static pressure ratio across the shock interms of upstream mach number. **(08 Marks)**

b. The state of gas with ($\gamma$ = 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, $T_X$ = 275 K. Calculate M, P, T and velocity of the gas downstream of the shock. Check and compare the calculated values with those given in the tables. **(08 Marks)**

**OR**

4 a. Derive the expression for Hugoniot equation of a moving normal shock wave. **(10 Marks)**

b. If the entropy change caused by a normal shock in an airstream is 200 J/kg.K. Determine 'M' ahead of the shock and the shock strength. **(06 Marks)**

### Module-3

5 a. Derive the Prandtl-Meyer relation for oblique shock wave in perfect gas. **(10 Marks)**

b. Briefly explain the flow past wedges with neat sketch. **(06 Marks)**

**OR**

6 a. Briefly explain the reflection and intersection of shocks and expansion waves. **(08 Marks)**

b. An oblique shock in air causes an entropy increase of 11.5 J/kg-K. If the shock angle is 25°, determine the Mach number ahead of the shock and the flow deflection angle if $M_2$ = 2.7. **(08 Marks)**

### Module-4

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

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. Briefly explain the characteristic features and operation of supersonic wind tunnels. **(08 Marks)**

b. Describe the pressure measurement procedure in Manometers. **(08 Marks)**

**OR**

10 a. Briefly explain the flow visualization techniques used in supersonic flow. **(08 Marks)**

b. Explain the shock tube device. Also mention its applications. **(08 Marks)**

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