Code No: RT31212 **R13** SET - 1

III B. Tech I Semester Regular/Supplementary Examinations, October/November - 2016
AERODYNAMICS - II
(Aeronautical Engineering)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B**)
2. Answering the question in **Part-A** is compulsory
3. Answer any **THREE** Questions from **Part-B**

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PART –A

1 a) How does the molecular weight of a gas effect its speed of sound? [3M]
b) The downstream Mach number in the case of an oblique shock wave may or may not be less than unity. Explain the statement. [4M]
c) Define critical Mach number. For a given airfoil, the critical Mach number is 0.8. Calculate the value of $\frac{p}{p_\infty}$ at the minimum pressure point where $M_\infty = 0.8$. [4M]
d) Using linearized theory, calculate the lift and drag coefficients for a flat plate at a 5^0 angle of attack in a Mach 3 flow. [3M]
e) What are the recent advances in hypersonic flows? [4M]
f) What are the dimensionless numbers used in similarity of flows? Write the expressions for them? [4M]

PART -B

2 a) Explain the phenomenon of choking in isentropic flow. [7M]
b) The pressure, temperature and Mach number upstream of a normal shock are 0.1 MPa, 300 K and 2.0 respectively. Determine the Mach number, pressure, temperature and velocity downstream the shock. [9M]

3 Air having an initial Mach number $M_1 = 2.0$ is deflected through an angle $\delta = 15^0$ by a frictionless surface. Assuming that a weak shock wave occurs calculate **i**) the downstream Mach number **ii**) wave angle **iii**) pressure ratio **iv**) temperature ratio. [16M]

4 Consider a subsonic compressible flow in cartesian coordinates where the velocity potential is given by $\phi(x,y) = V_\infty x + \frac{6.5}{\sqrt{(1-M_\infty^2)}} e^{-20.6\sqrt{1-M_\infty^2}\,y} \sin(20.6x)$ If the free stream properties are given by $V_\infty = 213.4 m/s, P_\infty = 1\ atm\ T_\infty = 288.3K,$ calculate the following properties at the location of (0.061m, 0.061 m): M, p and T. [16M]

5 Derive the expressions for lift and wave-drag coefficients for a flat plate at an angle of attack based on linearized supersonic theory. [16M]

6 a) Derive an expression for modified Newtonian law [8M]
b) Consider a flat plate at $\alpha = 15^0$ in a Mach 18 free stream. Using straight Newtonian theory, calculate lift and wave drag coefficients. [8M]

7 a) Explain the working of Laser – Doppler anemometer with a neat sketch. [10M]
b) The Mach number of a compressible flow is to be determined from static probe and Pitot tube measurements. If the static probe indicates 500 mm Hg suction and the pitot tube 350 mm Hg suction, determine the flow Mach number. [6M]

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