

GUJARAT TECHNOLOGICAL UNIVERSITY**B.E. Sem-IV Examination June- 2010****Subject code: 140102****Subject Name: Aerodynamics-I****Date: 19/06/2010****Time: 10.30 am – 01.00 pm****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1 (a)** Derive expression for the dimension of Rankine full oval body using the potential flow theory & principle of superposition. **07**
- (b)** Derive equation for velocity of sound **07**
- Q.2 (a)** Show that part of the flow given by the complex potential function $W = \text{arc cosh} \left(\frac{z}{c} \right)$ can represent irrotational flow in a converging diverging channel of constant depth. **07**
- (b)** A sink of strength $20 \text{ m}^2/\text{s}$ is situated 3m upstream of a source of $40 \text{ m}^2/\text{s}$ in an irrotational uniform stream. It is found that at the point 2.5 m equidistance from the source and sink, the velocity is normal to the line joining source and sink. Find the velocity at this point and the velocity of undisturbed stream **07**
- OR**
- (b)** A sink of strength $120 \text{ m}^2/\text{s}$ is situated 2m downstream from a source of equal strength in an irrotational uniform stream of 30 m/s. Find the fineness ratio of the oval formed by the streamline $\psi = 0$ **07**
- Q.3 (a)** Prove that shock wave always occur in supersonic flow. **07**
- (b)** Derive θ - β -M relation for oblique shockwave **07**
- OR**
- Q.3 (a)** Derive expression for Prandtl-Meyer function $\gamma(M)$ **07**
- (b)** A normal shockwave moves in a constant area tube. In region 1, $V_1 = 100 \text{ m/s}$, $T_1 = 30^\circ \text{C}$, and $P_1 = 0.7 \text{ atma}$. The shock speed with respect to a fixed coordinate system is 600 m/s. find the fluid property in the region 2. **07**
- Q.4 (a)** Define the term drag over a body and explain in detail the types of drag and the ways to reduce them. **07**
- (b)** Define center of pressure and derive its position at quarter chord point. In low speed wind tunnel at an angle of attack 4° , coefficient of lift and moment coefficient at quarter chord point are 0.85 and -0.09 respectively. Calculate the location of center of pressure w.r.t. chord. **07**
- OR**
- Q.4 (a)** Derive the energy equation in differential form for a fluid element fixed in a moving flow field. **07**
- (b)** With neat sketches explain the pressure distribution over an aerofoil surface for different incidence angles. **07**
- Q.5 (a)** Compare the finite wing and an infinite wing. Write a short note on the bound vortex system for a finite wing. **07**
- (b)** Draw the variation in coefficient of lift and drag with respect to angle of attack α . Also explain the effect of high aspect ratio and low aspect ratio on C_L - α curve. **07**
- OR**
- Q.5 (a)** With an example explain the designations for NACA 4 digits, 5 digits and 6 digits series. **07**
- (b)** Explain the forces and moments acting on an aircraft with their importance for an aircraft to fly. **07**