

GUJARAT TECHNOLOGICAL UNIVERSITY**BE- VIIIth SEMESTER-EXAMINATION – MAY- 2012****Subject code: 180105****Date: 08/05/2012****Subject Name: High Speed Aerodynamics and Experimental Techniques****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.

Important Relations for Hypersonic Shock:

$$1) \frac{p_2}{p_1} = \frac{2\gamma}{\gamma+1} M_1^2 \sin^2 \beta; \quad \frac{\rho_2}{\rho_1} = \frac{\gamma+1}{\gamma-1}; \quad \frac{T_2}{T_1} = \frac{2\gamma(\gamma-1)}{(\gamma+1)^2} M_1^2 \sin^2 \beta$$

$$2) \frac{u_2}{V_1} = 1 - \frac{2 \sin^2 \beta}{\gamma+1}; \quad \frac{v_2}{V_1} = \frac{\sin 2\beta}{\gamma+1}$$

$$3) C_p = \left(\frac{4}{\gamma+1} \right) \sin^2 \beta; \quad \text{Also in terms of K} \quad C_p = 2\theta^2 \left[\frac{\gamma+1}{4} + \sqrt{\left(\frac{\gamma+1}{4} \right) + \frac{1}{k^2}} \right]$$

Consider $\gamma=1.4$ for all cases.

- Q.1** (a) Write a short note on low density flows associated with hypersonic flow. **07**
 (b) Write a short note on *Lift Effect* in wind tunnels. **07**

- Q.2** (a) What is consequence of linearity? Explain solution by it in detail **07**
 (b) Explain Tangent wedge/ Tangent cone method for curved surfaces. **07**

OR

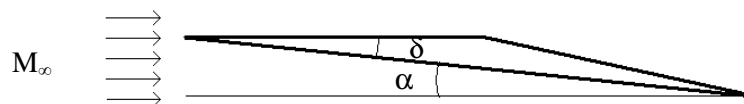
- (b) Explain Shock expansion technique for curved surfaces. **07**

- Q.3** (a) Explain conical flow method treatment for swept back wings. **07**
 (b) What are the design considerations for supersonic aircraft? **07**

OR

- Q.3** (a) Apply centrifugal force correction to Newtonian flow theory. **07**
 (b) A flat plate placed in a uniform flow of $M_\infty=25$, where various flow parameters are $P_\infty=20225 \text{ N/m}^2$ and $T_\infty=210 \text{ K}$. angle of attack of the plate is 4° . Calculate the downstream parameters across the shock like M , T , P , C_p and ρ using oblique shock relation. **07**

- Q.4** (a) Derive co-efficient of pressure for a flat plate submerged in uniform flow at angle α by using Newtonian flow theory. **07**
 (b) Calculate coefficient of lift and drag for airfoil given in the figure. **07**

Here $\alpha=\delta$ which is 3° and free stream mach number is 18.**OR**

- Q.4** (a) From equation of Newtonian flow obtain value of L/D for flat plate **07**
 (b) Derive co-efficient of pressure for hypersonic Prandtl Mayer flow in terms of hypersonic similarity parameter. **07**

- Q.5** (a) What is wind tunnel? Explain construction of subsonic open wind tunnel. **07**
(b) How boundary layer investigation is carried out experimentally? **07**
- OR**
- Q.5** (a) Explain construction & working of supersonic wind tunnels. **07**
(b) Enlist the optical methods of flow exploration and explain any one in detail. **07**
