Seat No.: _____   Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY
BE SEM-IV Examination-Nov/Dec-2011

Subject code: 140102   **Date: 30/11/2011**

Subject Name: Aerodynamics I

Time: 02.30 pm -5.00 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 momentum equation in Cartesian coordinates for three dimensional flows. Also derive Bernoulli's equation from the same and list the assumption.	**07**
	(b)	Prove that free vortex is an irrotational flow.	**07**
Q.2	**(a)**	Explain basic elementary flows and list their stream functions and potential functions.	**07**
	(b)	Give the physical meaning of stream function and potential function. Explain why potential function exists only for irrotational flow?	**07**

OR

	(b)	Fluid past circular cylinder having density 'ρ' kg/m^3 is moving with uniform stream of velocity 'U' m/s. Using potential flow theory show that lift generated is independent of the shape of the object.	**07**
Q.3	**(a)**	Write short notes on profile drag and induced drag.	**07**
	(b)	Explain phenomenon stalling. With the help of diagram explain influence of stalling on C_{lmax}	**07**

OR

Q.3	**(a)**	Explain downwash with suitable figure. List the effect of downwash on performance of an airfoil	**07**
	(b)	List the difference between symmetric airfoil and cambered airfoil. Show the pressure variation on symmetric airfoil and cambered airfoil for angle of attack α = -4, -2, 0, 4, 8, 12, 16 and 20 degree.	**07**
Q.4	**(a)**	Prove that shock always occurs in supersonic flows	**07**
	(b)	Show that Mach number downstream of the normal shock is always subsonic and downstream that of oblique shock is always less than upstream Mach number	**07**

OR

Q.4	**(a)**	Figure 1 shows the diamond wedge airfoil in super sonic flow. Derive the equations for the flow properties downstream of the shockwaves at station 1, 2 and 3	**07**
Q.4	**(b)**	Derive equation for airspeed measurement using Pitot-Static tube for compressible. What is the air speed range for consideration of incompressible flow and why?	**07**
Q.5	**(a)**	Explain shock expansion theory in detail.	**07**
	(b)	Define total condition. Derive expression for T_0/T , P_0/P and ρ_0/ρ in terms of Mach number	**07**

Q.5 **(a)** Why spike is used at the inlet of an aircraft flying at supersonic speed? **07**
Explain the shock formation and shock pattern.

(b) Write a short note on airspeed measurement for subsonic incompressible, **07**
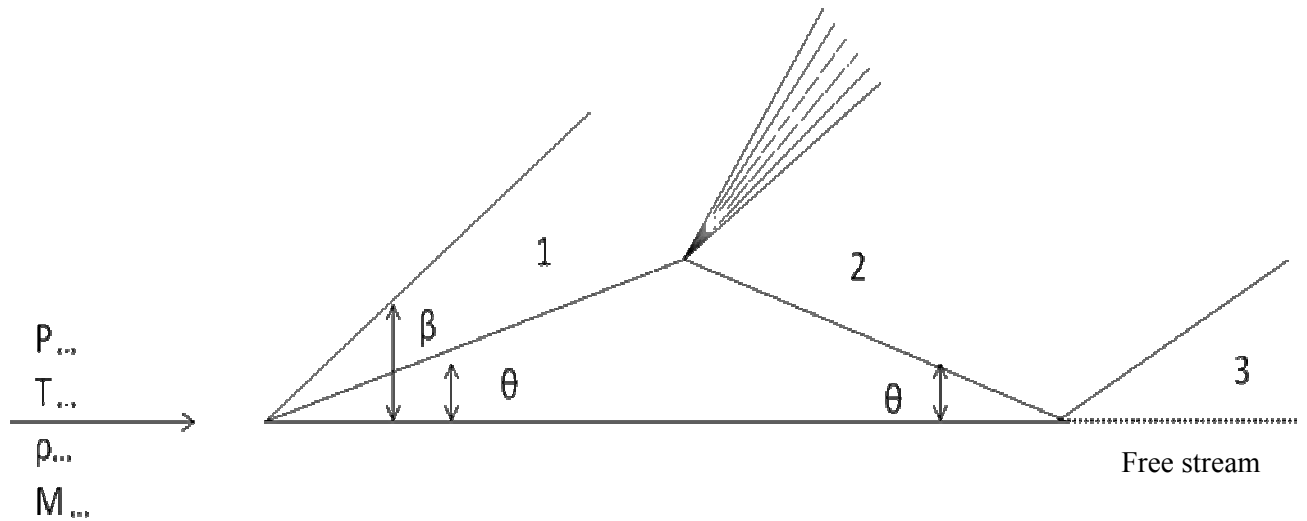subsonic compressible and supersonic flow.

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P_∞

T_∞

ρ_∞

M_∞

β θ 1 2 θ 3

Free stream

Figure 1