Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV • EXAMINATION – SUMMER • 2014

Subject Code: 140102 Date: 23-06-2014

Subject Name: Aerodynamics I

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)	At a point in airflow the pressure is 1 atm, the temperature is 320 k and velocity is 1000 m/s. Calculate the total temperature and total pressure at this point.	07
	(b)	Derive the Momentum equation.	07
Q.2	(a)	Derive the energy equation and explain application of Bernoulli's equation.	07
	(b)	Classify the NACA series standard for airfoils with a neat sketch.	07
		OR	
	(b)	Show that free vortex is an example of irrotational motion.	07
Q.3	(a)	Derive the equation of speed of sound. ($a = \sqrt{\gamma RT}$)	07
	(b)	Consider an airfoil in a flow at standard sea level conditions with a free stream velocity of 50 m/s. At a given point on the airfoil, the pressure is 0.9×10^5 N/m^2. Calculate the velocity at this point. At sea level, ρ_∞ = 1.23 kg/m^3 and p_∞ = 1.01×10^5 N/m^2.	07
		OR	
Q.3	(a)	Prove that, the product of flow velocities upstream and downstream of a normal shock wave is equal to the square of critical velocity of sound.	07
	(b)	State the assumptions for Kutta theorem and prove Kutta-Joukowsky lift theorem.	07
Q.4	(a)	Explain basic elementary flow in terms of stream function and potential function.	07
	(b)	Define the terms: - aspect ratio, angle of incidence, Mach Number, downwash, lift, drag, Control Volume.	07
		OR	
Q.4	(a)	Differentiate between normal shock wave, oblique shock wave and expansion wave with neat sketch.	07
	(b)	Derive Rankine – Hugoniot equation for oblique shock.	07
Q.5	(a)	Derive the equation of substantial derivative for fluid element moving in a flow field.	07
	(b)	Explain with neat sketches the forces and moments acting on an aircraft	07
		OR	
Q.5	(a)	Derive θ-β-M relation for inviscid, adiabatic flow with no body forces.	07
	(b)	Write a short note on flow over an airfoil.	07

****