Seat No.: ___________ Enrolment No.____________

GUJARAT TECHNOLOGICAL UNIVERSITY

B. E. Sem-VI Examination May 2011

Subject code: 160101

Subject Name: Aerodynamics-II

Date:16/05/2011 **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)** State and prove Kelvin's circulation theorem. Also explain how circulation and starting vortex can be generated? **07**

(b) Prove that coefficient of pressure is directly proportional to the local surface inclination with respect to free stream for linearized supersonic flow. **07**

Q.2 **(a)** Explain the vortex sheet and the vortex panel numerical method **07**

(b) Explain flow over airfoil in real case with help of suitable diagrams **07**

OR

(b) Derive fundamental equation for thin airfoil theory **07**

Q.3 **(a)** Explain Joukowsky transformation and transformation of circle in to circular arc airfoil **07**

(b) Calculate the velocity just outside the boundary at ¾ chord point of a symmetric Joukowsky airfoil of thickness chord ratio 0.2 set at zero incidence in a stream of undisturbed velocity of 50 m/s **07**

OR

Q.3 **(a)** show the transformation of circle in to cambered airfoil **07**

(b) A long strut of elliptic section and fineness ratio of 4 is set with a major axis of section at zero incidence to an irrotational stream of undisturbed velocity 50 m/s. Calculate the stream velocity just outside the boundary layer at a point of maximum thickness. **07**

Q.4 **(a)** Using Biot-Savart law, derive equation for induced velocity at a point for the infinite and semi-infinite vortex filament. **07**

(b) A thin airfoil has a camber line defined by the relation $y = kx\left(x-1\right)\left(x-2\right)$ where x and y are its coordinates expressed in terms of unit chord and the origin is at the leading edge. If the maximum camber is 2% of the chord, determined the low speed two dimensional pitching moment coefficient at 3° incidence. **07**

OR

Q.4 **(a)** Explain numerical lifting line method for non linear variation of c_l versus α **07**

(b) The mean camber line for NACA 23012 airfoil is given by **07**

$$\frac{z}{c} = 2.6595\left[\left(\frac{x}{c}\right)^3 - 0.6075\left(\frac{x}{c}\right)^2 + 0.1147\left(\frac{x}{c}\right)\right] \text{ for } 0 \le \frac{x}{c} \le 0.2025$$

and

$$\frac{z}{c} = 0.02208\left(1-\frac{x}{c}\right) \text{for } 0.2025 \le \frac{x}{c} \le 1.0$$

Calculate (a) angle of attack at zero lift and (b) moment coefficient about quarter chord point

Q.5	**(a)**	Show pressure distribution and lift distribution over slender bodies	**07**
	(b)	Explain drag divergence Mach number, Area rule and super critical airfoil	**07**

OR

Q.5	**(a)**	Explain Critical Mach number and derive the equation for the same. Also explain the effect of airfoil thickness on critical Mach number	**07**
	(b)	Write a short note on wing fuselage interference in incompressible flow	**07**

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