JAYA GROUP OF INSTITUTION-THIRUNINRAVUR

4th SEM – B.E. / B.Tech

INTERNAL ASSESSMENT-3(MODEL EXAM-III)

Sub. Name: Aerodynamics-I
Sub. Code: AE-6401
Duration: 180 minutes

Date: 09/ 04/2015
Branch: Aeronautical
Max.Marks: 100

Part A **10X2=20**

1. Define stream function and stream line
2. Discuss about the terms Substantial Derivative, Convective Derivative and Local Derivative
3. What is Vorticity?
4. Define Magnus Effect.
5. Distinguish between Free Vortex and Forced Vortex.
6. What are the basic assumptions of Thin aerofoil theory?
7. State Biot-Savart's Law.
8. Define Wash-in and Wash-out
9. What do you know by Shape factor?
10. What is a Laminar Sub-layer?

Part B **5X16=80**

11.(a) Derive the 3D Momentum Equation

OR

(b) Derive the continuity equation in Polar Co-ordinates

12. (a) (i) Does the velocity potential function □ $=2\{X^2+2Y-Y^2\}$ describe a flow of an incompressible fluid? If so, find out the equation for the resultant velocity vector and equation of stream line (8)

(ii) Prove that stream lines of a flow is always perpendicular to its velocity potential lines (8)

OR

(b) What is the condition for getting a spinning cylinder? Derive the stream function and potential function of it.

13. (a) (i) State and Prove Kutta Joukowski's Theorem (8)

(ii) Derive the Cauchy-Rieman Equation (8)

OR

(b) Based on conformal Transformation, show that a circle can be transformed into a cambered aerofoil and also obtain the expression for its thickness to chord ratio.

14. (a) (i) Derive the fundamental equation of Prandtl's Lifting line theory (8)

(ii) Derive the equation for induced velocity of an infinite vortex filament using Biot-Savart's Law. (8)

OR

(b) The mean camber line of a thin aerofoil is given by;

$\left(\frac{y}{c}\right) = 0.25\{ 0.8 \left(\frac{x}{c}\right) - \left(\frac{x}{c}\right)^2$ for $0 \leq \left(\frac{x}{c}\right) \leq 0.4$ &

$\left(\frac{y}{c}\right) = 0.111\{ 0.2 + 0.8 \left(\frac{x}{c}\right) - \left(\frac{x}{c}\right)^2$ for $0.4 \leq \left(\frac{x}{c}\right) \leq 1$. Calculate (i) Zero Lift angle of Attack and (ii) C_L when $\alpha = 3^o$

15. (a) (i) Derive the Navier-Stroke's equation for an incompressible and viscous flow (8)

(ii) Obtain the Blausis Solution for a flow over a flat plate (8).

OR

(b) Air at standard conditions flows over a flat plate kept parallel to the flow. The free stream velocity is 4m/s. Assume a velocity profile given by; $(u/U\infty) = \left(\frac{3}{2}\right)\left(\frac{y}{\delta}\right) - \left(\frac{1}{2}\right)\left(\left(\frac{y}{\delta}\right)^3\right)$. Assume $\gamma = 1.5X10^{-5}$ m^2/s and density is $1.226Kg/m^3$. Estimate the boundary layer thickness and wall shear stress at x=2m.