Code No: 07A42101 **R07** **Set No. 3**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
II B.TECH II SEM–REGULAR/SUPPLEMENTARY EXAMINATIONS MAY - 2010
AERODYNAMICS - I
Aeronautical Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Consider a source of uniform strength and obtain the stream lines from it.
   (b) Define and explain wall boundary condition and infinity boundary condition. [10+6]

2. (a) A 2-d point source with a strength 55 units is located G (2.5,3.45). Obtain the velocity potential ϕ (x,z) and velocity components (u,v) at P(5.5,5.5). Determine their numerical values as well.(T)
   (b) How does a vortex panel method differ from a source panel method and under what conditions? Hence describe the formulation of a vortex panel for a lifting flow over flat plate. [8+8]

3. (a) Define lift, drag, lift coefficient and drag coefficient.
   (b) Define and describe various drag coefficients. [8+8]

4. (a) Calculate the induced drag on a finite wing for a general lift distribution.
   (b) And the effect of Aspect Ratio on induced drag [8+8]

5. (a) A 2-D point source with a strength 50 units is located at T(1.0,1.57). Obtain the velocity potential ϕ (x,z) and velocity components(u,v) at P(3.5,2.5)
   (b) What are the preliminary considerations prior to establishing a numerical solution to an on lifting problem using "Source Panel" technique. Hence describe the types of boundary conditions to be satisfied by such a method. [8+8]

6. Derive the fundamental equation of thin airfoil theory,
   $(1/2\pi)\int[\{\gamma(\xi)d\xi\}/\{x-\xi\}] = V\{\alpha-(dz/dx)\}$, where the integration is carried out from the leading edge to the trailing edge of an airfoil and prove that the lift coefficient is proportional to angle of attack for a cambered airfoil. [16]

7. Consider a plane wing of AR 5, taper ratio 04 and swept back by 45^o. Develop the vortex lattice method to calculate lift coefficient for this wing. Take the root chord of the wing as C=1.0 unit. Divide the wing into 4 panels. [16]

8. (a) Show that the transformation
   $\zeta = z + (b^2/z) = \xi + i\eta$ leads to $\zeta = (r + b^2/r)\cos\theta + i(r - b2/r)\sin\theta$, where z is complex while ξ and η are real.
   (b) Hence show that $\zeta = f(z)$ transforms a circle a symmetrical airfoil if the origin of the circle is a (be, h) where b, h and e are constants. [6+10]

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