Code No: R05222102 **R05** **Set No. 2**

II B.Tech II Semester Examinations,December 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. The variation of circulation over a wing having elliptic plan form with span 'b' is given below :$\Gamma(y) = \Gamma_0\sqrt{1-\left(\frac{2y}{b}\right)^2}$ Show that
   (a) the wing has elliptical lift distribution
   (b) the downwash is constant along the wing planform
   (c) $\alpha_i = \frac{C_L}{\pi AR}$
   (d) $C_{Di} = \frac{C_L^2}{\pi AR}$. [16]

2. (a) A 2-d point source with a strength 50 units is located at T(1.0,1.58). 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 a non lifting problem using "Source Panel" technique. Hence describe the types of boundary conditions to be satisfied by such a method. [8+8]

3. Consider a planar wing of aspect ratio 5, taper ratio unity, and swept aft by 45^0 in the plane of symmetry. Develop the Vortex Lattic Method to calculate lift coefficient for this wing. Take the uniform chord of the wing as c = 1.0. Show as much of the work out. (Divide the wing in 2 panels) [16]

4. (a) Under what conditions does the velocity field V = $(a_1x + b_1y + c_1z)i + (a_2x + b_2y + c_2z)j + (a_3x + b_3y + c_3z)k$ represents an incompressible flow which conserves mass, where a_1, b_1 —— etc. are constants.
   (b) Determine the nature of constant potential lines due to a uniform source? [8+8]

5. (a) Consider flow over a cambered airfoil at $\alpha \neq 0^o$ in a real fluid. What are the forces and moments developed on the airfoil in this configuration? Make use of aerodynamics and sketches to explain the answer.
   (b) Demonstrate from the dimensional analysis of force over an airfoil that Drag force is a function of [α, Re,Ma, C_D] , with usual notations in aerodynamics. [8+8]

6. (a) A 2-d point vortex of strength 60 units is located at G(2.5,3.45). Develop an expression for velocity potential and that for velocity components(u,v) at P(5.5,5.5) . Determine their numerical values as well.

(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 method for a lifting flow over a flat plate in details. [8+8]

7. Given is the mean camber line of NACA 23012 airfoil section as below:
$\frac{z}{c} = 2.6595\left[(\frac{x}{c})^3 - 0.6075(\frac{x}{c})^2 + 0.1147(\frac{x}{c})\right]$ for $0 \leq \frac{x}{c} \leq 0.2025$ and $\frac{z}{c} = 0.02208(1-\frac{x}{c})$ for $0.2025 \leq \frac{x}{c} \leq 1.0$
Calculate

   (a) αat zero C_l,
   (b) C_l at $\alpha = 2.5^0$,
   (c) Cm at C/4. [16]

8. Make use of the Complex Potential Function theory to obtain flow around a non spinning circular cylinder. Work out its dimensions and streamlines over this object. Show that the pressure distribution over the circular cylinder is given by $C_p = (1 - 4Sin^2\theta)$. Present your work out. [8+8]

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Code No: R05222102 **R05** **Set No. 4**

II B.Tech II Semester Examinations,December 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. Consider a planar wing of aspect ratio 5, taper ratio unity, and swept aft by 45^0 in the plane of symmetry. Develop the Vortex Lattic Method to calculate lift coefficient for this wing. Take the uniform chord of the wing as c = 1.0. Show as much of the work out. (Divide the wing in 2 panels) [16]

2. (a) Consider flow over a cambered airfoil at $\alpha \neq 0^o$ in a real fluid. What are the forces and moments developed on the airfoil in this configuration? Make use of aerodynamics and sketches to explain the answer.

   (b) Demonstrate from the dimensional analysis of force over an airfoil that Drag force is a function of [α, Re,Ma, C_D] , with usual notations in aerodynamics. [8+8]

3. (a) A 2-d point source with a strength 50 units is located at T(1.0,1.58). 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 a non lifting problem using "Source Panel" technique. Hence describe the types of boundary conditions to be satisfied by such a method. [8+8]

4. (a) Under what conditions does the velocity field V = $(a_1x + b_1y + c_1z)i + (a_2x + b_2y+c_2z)j+(a_3x+b_3y+c_3z)k$ represents an incompressible flow which conserves mass, where a_1, b_1 —– etc. are constants.

   (b) Determine the nature of constant potential lines due to a uniform source? [8+8]

5. (a) A 2-d point vortex of strength 60 units is located at G(2.5,3.45). Develop an expression for velocity potential and that for velocity components(u,v) at P(5.5,5.5) . Determine their numerical values as well.

   (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 method for a lifting flow over a flat plate in details. [8+8]

6. Make use of the Complex Potential Function theory to obtain flow around a non spinning circular cylinder. Work out its dimensions and streamlines over this object. Show that the pressure distribution over the circular cylinder is given by $C_p = (1 - 4Sin^2\theta)$. Present your work out. [8+8]

7. Given is the mean camber line of NACA 23012 airfoil section as below:
   $\frac{z}{c} = 2.6595\left[(\frac{x}{c})^3 - 0.6075(\frac{x}{c})^2 + 0.1147(\frac{x}{c})\right]$ for $0 \leq \frac{x}{c} \leq 0.2025$ and $\frac{z}{c} = 0.02208(1-$

$\frac{x}{c}$) for $0.2025 \leq \frac{x}{c} \leq 1.0$
Calculate

(a) αat zero C_l,

(b) C_l at $\alpha = 2.5^0$,

(c) Cm at C/4. [16]

8. The variation of circulation over a wing having elliptic plan form with span 'b' is given below :$\Gamma(y) = \Gamma_0\sqrt{1 - \left(\frac{2y}{b}\right)^2}$ Show that

(a) the wing has elliptical lift distribution

(b) the downwash is constant along the wing planform

(c) $\alpha_i = \frac{C_L}{\pi AR}$

(d) $C_{Di} = \frac{C_L^2}{\pi AR}$. [16]

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Code No: R05222102 **R05** **Set No. 1**

II B.Tech II Semester Examinations,December 2010
AERODYNAMICS - I
Aeronautical Engineering

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

Answer any FIVE Questions
All Questions carry equal marks

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2. (a) Under what conditions does the velocity field V = $(a_1x + b_1y + c_1z)i + (a_2x + b_2y+c_2z)j+(a_3x+b_3y+c_3z)k$ represents an incompressible flow which conserves mass, where a_1, b_1 —– etc. are constants.
   (b) Determine the nature of constant potential lines due to a uniform source? [8+8]

3. Consider a planar wing of aspect ratio 5, taper ratio unity, and swept aft by 45^0 in the plane of symmetry. Develop the Vortex Lattic Method to calculate lift coefficient for this wing. Take the uniform chord of the wing as c = 1.0. Show as much of the work out. (Divide the wing in 2 panels) [16]

4. Make use of the Complex Potential Function theory to obtain flow around a non spinning circular cylinder. Work out its dimensions and streamlines over this object. Show that the pressure distribution over the circular cylinder is given by $C_p = (1 - 4Sin^2\theta)$. Present your work out. [8+8]

5. Given is the mean camber line of NACA 23012 airfoil section as below:
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   (b) C_l at α= 2.5^0,
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   (b) What are the preliminary considerations prior to establishing a numerical solution to a non lifting problem using "Source Panel" technique. Hence describe the types of boundary conditions to be satisfied by such a method. [8+8]

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Code No: R05222102 **R05** **Set No. 3**

II B.Tech II Semester Examinations,December 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. Make use of the Complex Potential Function theory to obtain flow around a non spinning circular cylinder. Work out its dimensions and streamlines over this object. Show that the pressure distribution over the circular cylinder is given by $C_p = (1 - 4Sin^2\theta)$. Present your work out. [8+8]

2. (a) Consider flow over a cambered airfoil at $\alpha \neq 0^o$ in a real fluid. What are the forces and moments developed on the airfoil in this configuration? Make use of aerodynamics and sketches to explain the answer.
   (b) Demonstrate from the dimensional analysis of force over an airfoil that Drag force is a function of [α, Re,Ma, C_D] , with usual notations in aerodynamics. [8+8]

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   (a) αat zero C_l,
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