Code No: 07A42101 **Set No. 1**

II B.Tech II Semester Regular Examinations, Apr/May 2009
AERODYNAMCS-I
(Aeronautical Engineering)

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

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Select and draw neat sketches of symmetric and unsymmetric 4 digit NACA airfoils (specify the numbers), and explain the main features.
   (b) Explain the advantages and disadvantages of these two. [8+8]

2. Describe various flows like viscous, inviscid, compressible, incompressible, rotational and irrotational, and the effects on a wing. [16]

3. Write short notes on:
   (a) Stream function.
   (b) Velocity potential.
   (c) Complex numbers
   (d) Complex Potential Function. [4+4+4+4]

4. State and explain the limitations of thin airfoil theory. [16]

5. When a finite wing is replaced by a single horseshoe vortex, it is known that downwash at the tips become infinite. As we know this is unrealistic. Suggest and explain the remedy for this problem? Also obtain the expression for down wash. [16]

6. 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]

7. (a) A 2-d point source with a strength 50 units is located at T(1.0,1.52). 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 establish a numerical solution to a non lifting problem using "source panel method" technique. Hence describe types of boundary conditions to be satisfied by such a method. [8+8]

8. (a) Describe in brief the merits of 'Lifting Surface Theory' for predicting lift dis tribution on a wing with an arbitrary planform. Make use of sketches and other representations in this regard.
   (b) Compare the formulation in (a) above with that in the classical lifting line theory with details. [8+8]

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Code No: 07A42101 **Set No. 2**

II B.Tech II Semester Regular Examinations, Apr/May 2009
AERODYNAMCS-I
(Aeronautical Engineering)

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

Answer any FIVE Questions
All Questions carry equal marks

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

2. Write short notes on:
   (a) rotational and irrotational flows
   (b) steady and unsteady flows
   (c) inviscid and viscous flows
   (d) Continuity. [4+4+4+4]

3. Consider a velocity field where the x and y components of velocity are given by u = cx and v = cy, where c is a constant. Assume the flow to be incompressible, calculate the stream function and velocity potential. Using the results, show that lines of constant ϕ are perpendicular lines of constant ψ. [16]

4. 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 a symmetrical airfoil and prove that the lift coefficient is proportional to angle of attack for a symmetrical airfoil. [16]

5. Derive the fundamental equation of Prandtl's lifting line theory and calculate the drag coefficient on the finite wing. [16]

6. Explain in detail about the lift, drag and moment characteristics of complete airplane. [16]

7. A solution to the Laplace equation for incompressible potential flow and pressure distribution over a circular cylinder is sought by a numerical technique. Making use 16th numbers constant source panels develop the procedure for obtaining pressure distribution over a given circular cylinder. [16]

8. Explain about the lifting flow over arbitrary body like an airfoil section with necessary theory and expressions. [16]

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

II B.Tech II Semester Regular Examinations, Apr/May 2009
AERODYNAMCS-I
(Aeronautical Engineering)

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

Answer any FIVE Questions
All Questions carry equal marks

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1. Draw a neat sketch of an airfoil section and explain the parameters defining an airfoil. What are the different types of airfoils? Explain the advantages and disadvantages of these? [16]

2. Describe various flows like viscous, inviscid, compressible, incompressible, rotational and irrotational, and the effects on a wing. [16]

3. (a) Define the potential function (velocity potential) of a flow. What are the conditions to be imposed on the flow for this function to be definable?
   (b) Define the stream function of a flow. What are the conditions to be imposed on the flow for this function to be definable? [8+8]

4. (a) Derive the moment coefficient about the leading edge for a cambered airfoil.
   (b) Derive the expression for the distance of the centre of pressure from the leading edge of a cambered airfoil. [12+4]

5. How is downwash produced on a finite wing? Explain its effect on the wing. [16]

6. 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]

7. (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]

8. Elobrate the steps towards constructing a numerical solution in case of a vortex panel method. Specify the solution method for the laplaces equation and the type of boundary conditions to be satisfied in detail. [16]

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Code No: 07A42101 **Set No. 4**

II B.Tech II Semester Regular Examinations, Apr/May 2009
AERODYNAMCS-I
(Aeronautical Engineering)

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

Answer any FIVE Questions
All Questions carry equal marks

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1. Why are different airfoils and wings required for subsonic aircraft and supersonic aircraft? Explain using neat sketches. Is it possible to have different airfoils for a supersonic aircraft while it flies in subsonic and supersonic regimes? [16]

2. Consider a body of arbitrary shape. If the pressure distribution is constant, prove that the resultant drag on the body is Zero. [16]

3. Consider a velocity field where the x and y components of velocity are given by u = cx and v = cy, where c is a constant. Assume the flow to be incompressible, calculate the stream function and velocity potential. Using the results, show that lines of constant ϕ are perpendicular lines of constant ψ. [16]

4. Consider a thin flat plate at 5 degree angle of attack. Calculate
   (a) the lift coefficient,
   (b) the moment coefficient about the leading edge,
   (c) moment coefficient about the quarter chord point,
   (d) moment coefficient about the trailing edge. [4+4+4+4]

5. Explain in detail how we can replace a finite wing by a bound vortex along with expressions and also with neat sketches. [16]

6. (a) Lifting surface theory predicts better lift distribution on a wing with a low aspect ratio and of any type of given planform'. Can you demonstrate the verification of the statement?
   (b) Compare the formulation in (a) above with that in the classical lifting line theory with details. [8+8]

7. (a) A 2-d point source with a strength 50 units is located at T(1.0,1.52). 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 establish a numerical solution to a non lifting problem using "source panel method" technique. Hence describe types of boundary conditions to be satisfied by such a method. [8+8]

8. Explain the panel method used for lifting flows. [16]

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