Code: 9A21403

1

B.Tech II Year II Semester (R09) Regular & Supplementary Examinations, April/May 2013

AERODYNAMICS - I

(Aeronautical Engineering)

Time: 3 hours   Max. Marks: 70

Answer any FIVE questions
All questions carry equal marks

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1. Perform the dimensional analysis to determine the physical quantities the determine the variation in aerodynamic forces and moments.

2. Define uniform flow. Obtain an expression for velocity potential and stream function in uniform flow.

3. (a) What are the effects of boundary layer separation? Explain using neat sketches.
   (b) State Reynold's analogy.

4. Derive the expression for lift and moment acting over a thin cambered airfoil placed in an incompressible, inviscid flow at a given angle of attack.

5. Derive the fundamental equation of Prandtl's lifting line theory. Obtain the expressions for lift and induced drag. Make necessary assumptions.

6. Explain the mechanism of lift generation over a delta wing.

7. Explain
   (a) Leading edge devices for lift augmentation.
   (b) Power – augmented lift.

8. Explain the geometry of the propeller using neat sketches.

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2

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B.Tech II Year II Semester (R09) Regular & Supplementary Examinations, April/May 2013

AERODYNAMICS - I

(Aeronautical Engineering)

Time: 3 hours Max. Marks: 70

Answer any FIVE questions
All questions carry equal marks

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1. (a) What are the sources of aerodynamic forces and moments? Explain using neat sketches the aerodynamic forces and moments acting on a body.
   (b) Derive the continuity equation in integral form, suitable for all types of flows.

2. (a) Obtain the velocity potential and stream function expressions for the flow over a Rankine oval.
   (b) Define doublet flow. Obtain the velocity potential and stream function expressions for the flow.

3. Explain using a neat sketch the boundary layer growth for the flow over a flat plate. Define the thickness of a boundary layer.

4. Obtain the expressions for lift and moment acting over a thin symmetrical airfoil placed in an incompressible, inviscid flow at given angle of attack.

5. State the fundamental equation and extend the concept to a general straight rectangular wing.

6. Analyze the flow field about an aircraft at high angles of attack using neat sketches.

7. Write a short notes on:
   (a) Drag polar.
   (b) Lift to drag ratio.
   (c) Super critical airfoils.

8. Define the vortex system of an airscrew.

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B.Tech II Year II Semester (R09) Regular & Supplementary Examinations, April/May 2013

AERODYNAMICS - I

(Aeronautical Engineering)

Time: 3 hours Max. Marks: 70

Answer any FIVE questions
All questions carry equal marks

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1. (a) Define flow similarity parameters and dynamically similar flows.
   (b) Derive the energy equation in integral form, assuming a suitable flow model.

2. Analyze the non lifting flow over a circular cylinder and plot the theoretical pressure distribution over the surface of the body.

3. Define
   (a) Eddy viscosity.
   (b) Laminar, turbulent boundary layers.

4. (a) State Kelvin's circulation theorem and define starting vortex.
   (b) Explain the effect of boundary layer transition and surface roughness on the aerodynamic forces.

5. State and explain.
   (a) Biot-Savart's law for a vortex filament.
   (b) Hemholtz's theorem.
   (c) Down wash and induced drag.

6. Analyze the inviscid and incompressible flow over a sphere. Plot a pressure distribution graph over the surface of the sphere.

7. Explain briefly the drag reduction techniques used in wings.

8. Define for a propeller, and their effect on air screw performance.
   (a) Airscrew pitch.
   (b) Geometric pitch.
   (c) Experimental mean pitch.

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4

Code: 9A21403

B.Tech II Year II Semester (R09) Regular & Supplementary Examinations, April/May 2013

AERODYNAMICS - I

(Aeronautical Engineering)

Time: 3 hours Max. Marks: 70

Answer any FIVE questions
All questions carry equal marks

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1. Derive the momentum equation in integral form, for both inviscid and viscous flows, assuming a suitable flow model.

2. Analyze the lifting flow over the cylinder, obtain an expression for lift per unit span over a two dimensional body.

3. Define turbulence modeling using Baldwin-Lomax turbulence model.

4. State or define, using neat sketches.
   (a) Kutta condition.
   (b) Kelvin's circulation theorem and starting vortex.

5. State the fundamental equation of Prandtl's lifting line theory. Extend the concept for elliptical wing.

6. Define:
   (a) Three dimensional source.
   (b) Three dimensional doublet.

7. What are the lift augmentation methods employed on a wing surface? Explain using neat sketches.

8. Derive the relation between thrust, power for an ideal actuator disk using Rankine – Froude momentum theory.

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