Code No: R05222102 | R05 | SET 1

B.Tech II Year - II Semester Examinations, April/May-2012
AERODYNAMICS - I
(Aeronautical Engineering)

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

Answer any five questions
All questions carry equal marks
- - -

1. Make use of the thin airfoil theory to work out an expression for C1 and Cm for a flat plate of chord 150 mm. Obtain the results at $\alpha = 1^0$. Where does the centre of pressure lie in this case? What is C_{mLE} in this case? [16]

2. What are the basic features of the Kutta-Joukowaki transformation? Show that on application of Kutta-Joukowaski transformation, a circle transforms to
a) a flat plate and
b) an ellipse.
Extend the procedure further to transform a circle into a cambered airfoil. [8+8]

3. Take a low aspect ratio tapered planform with LE sweep. Make use of Lifting surface theory to develop the following expression (present your work out)

$$w(x,y) = -\frac{1}{4\pi}\iint_s \frac{(x-\xi)\gamma(\xi,\eta)+(\gamma-\eta)\delta(\xi,\eta)}{\left[(x-\xi)^2+(y-\eta)^2\right]^{3/2}} d\xi d\eta - \frac{1}{4\pi}\iint_w \frac{(\gamma-\eta)\delta(\xi,\eta)}{\left[(x-\xi)^2+(y-\eta)^2\right]^{3/2}} d\xi d\eta$$

Where the terminology is standard is standard for such work in aerodynamics. [16]

4.a) Explain the term Drag Polar as referred to the airplane drag. What are its components? Explain each with example.
b) Compare the drag force on
i) a flat plate at $\alpha \neq 0$ and
ii) symmetrical airfoil at $\alpha \neq 0$. [8+8]

5. A solution to the Laplace's equaiton for incompressible potential flow and pressure distribution over s circular cylinder is sought by a numerical technique. Making use of fourteen numbers of constant source panels develop the procedure for obtaining pressure distribution over the circular cylinder. [16]

6.a) Prove from the first pricniple that the condition for a flow field to be 'irrotational' is represented by, $\nabla \times \nabla\phi = 0$ where ϕ is defined as velocity potential function.
b) Demonstrate that the stream lines formed by a uniform source are radial lines originating from the centre of the source. [8+8]

7.a) Enumerate Biot-Savart's law.
b) Describe its application in calculating vortex induced velocities aerodynamics, Considering
i) a finite length vortex filament,
ii) an infinite length vortex filament and
iii) a semi-infinite length vortex filament each having circulation Γ.

Work our general expressions for vortex induced velocities in each of these three cases. [4+4+4+4]

8.a) Explain difference between
i) a point vortex,
ii) a constant strength vortex panel and
iii) a linearly varying strength vortex panel. Make a comparison of the three in your judgment, and bring out your conclusions.

b) A planar horse shoe vortex is placed symmetrically along OX on the x-axis with its BV (bound vortex) aligned with the y axis. Derive a general expression for the down wash in the plane of symmetry. [8+8]

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Code No: R05222102 | R05 | SET 2

B.Tech II Year - II Semester Examinations, April/May-2012
AERODYNAMICS - I
(Aeronautical Engineering)

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

Answer any five questions
All questions carry equal marks
- - -

1. Take a low aspect ratio tapered planform with LE sweep. Make use of Lifting surface theory to develop the following expression (present your work out)

$$w(x,y) = -\frac{1}{4\pi}\iint_s \frac{(x-\xi)\gamma(\xi,\eta)+(\gamma-\eta)\delta(\xi,\eta)}{\left[(x-\xi)^2+(y-\eta)^2\right]^{3/2}}d\xi d\eta - \frac{1}{4\pi}\iint_w \frac{(\gamma-\eta)\delta(\xi,\eta)}{\left[(x-\xi)^2+(y-\eta)^2\right]^{3/2}}d\xi d\eta$$

Where the terminology is standard is standard for such work in aerodynamics. [16]

2.a) Explain the term Drag Polar as referred to the airplane drag. What are its components? Explain each with example.

b) Compare the drag force on
i) a flat plate at $\alpha \neq 0$ and
ii) symmetrical airfoil at $\alpha \neq 0$. [8+8]

3. A solution to the Laplace's equaiton for incompressible potential flow and pressure distribution over s circular cylinder is sought by a numerical technique. Making use of fourteen numbers of constant source panels develop the procedure for obtaining pressure distribution over the circular cylinder. [16]

4.a) Prove from the first pricniple that the condition for a flow field to be 'irrotational' is represented by, $\nabla \times \nabla\phi = 0$ where ϕ is defined as velocity potential function.

b) Demonstrate that the stream lines formed by a uniform source are radial lines originating from the centre of the source. [8+8]

5.a) Enumerate Biot-Savart's law.

b) Describe its application in calculating vortex induced velocities aerodynamics, Considering
i) a finite length vortex filament,
ii) an infinite length vortex filament and
iii) a semi-infinite length vortex filament each having circulation Γ.
Work our general expressions for vortex induced velocities in each of these three cases. [4+4+4+4]

6.a) Explain difference between
i) a point vortex,
ii) a constant strength vortex panel and
iii) a linearly varying strength vortex panel. Make a comparison of the three in your judgment, and bring out your conclusions.

b) A planar horse shoe vortex is placed symmetrically along OX on the x-axis with its BV (bound vortex) aligned with the y axis. Derive a general expression for the down wash in the plane of symmetry. [8+8]

7. Make use of the thin airfoil theory to work out an expression for C1 and Cm for a flat plate of chord 150 mm. Obtain the results at $\alpha = 1^0$. Where does the centre of pressure lie in this case? What is C_{mLE} in this case? [16]

8. What are the basic features of the Kutta-Joukowaki transformation? Show that on application of Kutta-Joukowaski transformation, a circle transforms to
a) a flat plate and
b) an ellipse.
Extend the procedure further to transform a circle into a cambered airfoil. [8+8]

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Code No: R05222102 | R05 | SET 3

B.Tech II Year - II Semester Examinations, April/May-2012
AERODYNAMICS - I
(Aeronautical Engineering)

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

Answer any five questions
All questions carry equal marks
- - -

1. A solution to the Laplace's equaiton for incompressible potential flow and pressure distribution over s circular cylinder is sought by a numerical technique. Making use of fourteen numbers of constant source panels develop the procedure for obtaining pressure distribution over the circular cylinder. [16]

2.a) Prove from the first pricniple that the condition for a flow field to be 'irrotational' is represented by, $\nabla \times \nabla \phi = 0$ where ϕ is defined as velocity potential function.
b) Demonstrate that the stream lines formed by a uniform source are radial lines originating from the centre of the source. [8+8]

3.a) Enumerate Biot-Savart's law.
b) Describe its application in calculating vortex induced velocities aerodynamics, Considering
i) a finite length vortex filament,
ii) an infinite length vortex filament and
iii) a semi-infinite length vortex filament each having circulation Γ.
Work our general expressions for vortex induced velocities in each of these three cases. [4+4+4+4]

4.a) Explain difference between
i) a point vortex,
ii) a constant strength vortex panel and
iii) a linearly varying strength vortex panel. Make a comparison of the three in your judgment, and bring out your conclusions.
b) A planar horse shoe vortex is placed symmetrically along OX on the x-axis with its BV (bound vortex) aligned with the y axis. Derive a general expression for the down wash in the plane of symmetry. [8+8]

5. Make use of the thin airfoil theory to work out an expression for C1 and Cm for a flat plate of chord 150 mm. Obtain the results at $\alpha = 1^0$. Where does the centre of pressure lie in this case? What is C_{mLE} in this case? [16]

6. What are the basic features of the Kutta-Joukowaki transformation? Show that on application of Kutta-Joukowaski transformation, a circle transforms to
a) a flat plate and
b) an ellipse.
Extend the procedure further to transform a circle into a cambered airfoil. [8+8]

7. Take a low aspect ratio tapered planform with LE sweep. Make use of Lifting surface theory to develop the following expression (present your work out)

$$w(x,y) = -\frac{1}{4\pi}\iint_s \frac{(x-\xi)\gamma(\xi,\eta)+(\gamma-\eta)\delta(\xi,\eta)}{\left[(x-\xi)^2+(y-\eta)^2\right]^{3/2}} d\xi d\eta - \frac{1}{4\pi}\iint_w \frac{(\gamma-\eta)\delta(\xi,\eta)}{\left[(x-\xi)^2+(y-\eta)^2\right]^{3/2}} d\xi d\eta$$

Where the terminology is standard is standard for such work in aerodynamics.

[16]

8.a) Explain the term Drag Polar as referred to the airplane drag. What are its components? Explain each with example.

b) Compare the drag force on
i) a flat plate at $\alpha \neq 0$ and
ii) symmetrical airfoil at $\alpha \neq 0$. [8+8]

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Code No: R05222102 | R05 | SET 4

B.Tech II Year - II Semester Examinations, April/May-2012
AERODYNAMICS - I
(Aeronautical Engineering)

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

Answer any five questions
All questions carry equal marks
- - -

1.a) Enumerate Biot-Savart's law.

b) Describe its application in calculating vortex induced velocities aerodynamics, Considering
i) a finite length vortex filament,
ii) an infinite length vortex filament and
iii) a semi-infinite length vortex filament each having circulation Γ.
Work our general expressions for vortex induced velocities in each of these three cases. [4+4+4+4]

2.a) Explain difference between
i) a point vortex,
ii) a constant strength vortex panel and
iii) a linearly varying strength vortex panel. Make a comparison of the three in your judgment, and bring out your conclusions.

b) A planar horse shoe vortex is placed symmetrically along OX on the x-axis with its BV (bound vortex) aligned with the y axis. Derive a general expression for the down wash in the plane of symmetry. [8+8]

3. Make use of the thin airfoil theory to work out an expression for C1 and Cm for a flat plate of chord 150 mm. Obtain the results at $\alpha = 1^0$. Where does the centre of pressure lie in this case? What is C_{mLE} in this case? [16]

4. What are the basic features of the Kutta-Joukowaki transformation? Show that on application of Kutta-Joukowaski transformation, a circle transforms to
a) a flat plate and
b) an ellipse.
Extend the procedure further to transform a circle into a cambered airfoil. [8+8]

5. Take a low aspect ratio tapered planform with LE sweep. Make use of Lifting surface theory to develop the following expression (present your work out)

$$w(x,y) = -\frac{1}{4\pi}\iint_s \frac{(x-\xi)\gamma(\xi,\eta)+(\gamma-\eta)\delta(\xi,\eta)}{\left[(x-\xi)^2+(y-\eta)^2\right]^{3/2}}d\xi d\eta - \frac{1}{4\pi}\iint_w \frac{(\gamma-\eta)\delta(\xi,\eta)}{\left[(x-\xi)^2+(y-\eta)^2\right]^{3/2}}d\xi d\eta$$

Where the terminology is standard is standard for such work in aerodynamics. [16]

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i) a flat plate at $\alpha \neq 0$ and

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b) Demonstrate that the stream lines formed by a uniform source are radial lines originating from the centre of the source. [8+8]

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