CBCS Scheme

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15AE42

# Fourth Semester B.E. Degree Examination, June/July 2018
## Aerodynamics – I

Time: 3 hrs. Max. Marks: 80

**Note:** ***Answer FIVE full questions, choosing one full question from each module.***



### Module-1

1 a. Derive the integral and differential form of momentum equation using control volume approach. **(10 Marks)**

b. Explain briefly Mach number regimes with relevant sketches of flow over an airfoil. **(06 Marks)**

**OR**

2 a. Define the following with relevant figures and expression:
(i) Path line
(ii) Stream line
(iii) Streak line.
(iv) Angular velocity
(v) Circulation. **(10 Marks)**

b. Derive the relationship between:
(i) Stream function and velocity potential function.
(ii) Vorticity and Circulation. **(06 Marks)**

### Module-2

3 a. With a neat sketch explain in detail the Airfoil nomenclature. **(06 Marks)**

b. (i) Explain the geometrical parameters of Airfoil and Wing geometry with neat sketch. **(06 Marks)**

(ii) Define and explain in detail about the fundamental aerodynamic variable. **(04 Marks)**

**OR**

4 a. Derive the relation to calculate the Aerodynamic forces N' and A' and the momentum $M'_{LE}$ in terms of P, $\theta$ and $\tau$. **(08 Marks)**

b. (i) Consider the velocity field given by $u = \frac{Y}{(x^2+y^2)}$ and $v = \frac{-x}{(x^2+y^2)}$. Calculate the equation of stream line passing through the point (0, 4) **(04 Marks)**

(ii) Define the terms :
- Center of pressure
- Co-efficient of pressure.
- Aerodynamic center. **(04 Marks)**

### Module-3

5 a. Generate a flow over a circular cylinder by superposition of elementary flows and derive the expression for lift per span and also obtain the location of stagnation point for three different values of circulation. **(08 Marks)**

b. Derive the stream function and velocity potential equation for a doublet flow. **(08 Marks)**

**OR**

6 a. Briefly explain the following with relevant sketches:
   (i) Kelvin's circulation theorem and starting vortex. **(04 Marks)**
   (ii) Kutta's condition. **(04 Marks)**

   b. Obtain the expression $dcl/dx$ for a symmetric Airfoil using classical Airfoil theory. **(08 Marks)**

## Module-4

7 a. Explain and derive Prandtl's lifting theory and its limitation. **(08 Marks)**

   b. Explain the following:
   (i) Biot Savart law. **(03 Marks)**
   (ii) Helmholtz theorem. **(03 Marks)**
   (iii) Downwash. **(02 Marks)**

**OR**

8 a. Prove that induced drag co-efficient is directly proportional to square of lift co-efficient using elliptical lift distribution. **(08 Marks)**

   b. Explain in detail about lifting surface theory and vortex lattice method. **(08 Marks)**

## Module-5

9 a. (i) Discuss the advantages of swept Wings in model airplane.
   (ii) Write a note on simplified horse shoe vortex model. **(08 Marks)**

   b. Explain in detail about lift enhancing devices. **(08 Marks)**

**OR**

10 a. Write a short note on the following:
   (i) Trans sonic area rule.
   (ii) Super critical airfoil. **(08 Marks)**

   b. Write a short note on :
   (i) Critical Mach number.
   (ii) Drag divergence Mach number. **(08 Marks)**

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