CBCS SCHEME

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18AE/AS42

# Fourth Semester B.E. Degree Examination, June/July 2023
## Aerodynamics – I

Time: 3 hrs. Max. Marks: 100

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



### Module-1

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

b. Define the following :
(i) Streak line
(ii) Path line
(iii) Circulation
(iv) Velocity potential function.
(v) Stream function **(10 Marks)**

**OR**

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

b. Derive the relationship between :
(i) Vorticity and circulation
(ii) Stream function and Velocity potential function **(10 Marks)**

### Module-2

3 a. Derive the relation to calculate the Aerodynamic forces N′ and A′ and the momentum $M'_{LE}$ in terms of P, $\theta$ and $\tau$. **(10 Marks)**

b. With neat sketches, explain (i) Airfoil nomenclature (ii) Wing planform geometry. **(10 Marks)**

**OR**

4 a. In detail explain different types of Drag. **(10 Marks)**

b. Explain the following :
(i) Aerodynamic centre
(ii) Centre of pressure
(iii) Pressure coefficient
(iv) Aerodynamic forces and moments **(10 Marks)**

### Module-3

5 a. Derive an expression non lifting flow over a circular cylinder. **(10 Marks)**

b. Define : (i) Source flow (ii) Sink flow (iii) Doublet
(iv) Vortex flow (v) Uniform flow **(10 Marks)**

**OR**

6 a. Derive an expression for left co-efficient for symmetrical airfoil, using classical thin airfoil theory. **(10 Marks)**

b. Briefly explain the following, with neat sketches and relevant expressions :

(i) Kelvin's circulation theorem.

(ii) The starting vortex. **(10 Marks)**

## Module-4

7 a. Discuss the following :

(i) Biot-Savart law and Helmholtz's theorems.

(ii) Downwash and induced drag. **(10 Marks)**

b. Derive Prandtl's classical lifting line theory. **(10 Marks)**

**OR**

8 a. Prove that induced drag co-efficient is directly proportional to square of left co-efficient using elliptical lift distribution. **(10 Marks)**

b. Obtain the fundamental equation of Prandtl's lifting-line theory. **(10 Marks)**

## Module-5

9 a. Describe simplified horse-shoe vortex model. **(10 Marks)**

b. Explain the following :

(i) Formation flight.

(ii) Ground effects. **(10 Marks)**

**OR**

10 a. Write a short note on :

(i) Drag divergence mach number.

(ii) Subsonic and supersonic leading edges. **(10 Marks)**

b. Write a short notes on :

(i) Trans sonic area rule.

(ii) Critical Mach number. **(10 Marks)**

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