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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 , θ and τ . (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 (10 Marks)
- (iv) Vortex flow (v) Uniform flow

OR

- 6 a. Derive an expression for lift co-efficient for symmetrical airfoil, using classical thin airfoil theory. (10 Marks)
- b. Briefly explain the following, with neat sketches and relevant expressions :
- Kelvin's circulation theorem.
 - The starting vortex. (10 Marks)

Module-4

- 7 a. Discuss the following :
- Biot-Savart law and Helmholtz's theorems.
 - 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 lift 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 :
- Formation flight.
 - Ground effects. (10 Marks)

OR

- 10 a. Write a short note on :
- Drag divergence mach number.
 - Subsonic and supersonic leading edges. (10 Marks)
- b. Write a short notes on :
- Transonic area rule.
 - Critical Mach number. (10 Marks)

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