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Fourth Semester B.E. Degree Examination, Dec.2024/Jan.2025 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 form of momentum equation by control volume approach. (10 Marks)
- b. Explain the types of flow in fluids. (06 Marks)
- c. Explain the following terms :
 - (i) Stream lines
 - (ii) Streak lines. (04 Marks)

OR

- 2 a. What is compressible and incompressible flow? High speed flow in gases are highly compressibly, why? (04 Marks)
- b. The stream function for an incompressible, two dimensional flow field is, $\psi = ay^2 - bx$. Where a and b are constants. Is this an irrotational flow? Explain. (06 Marks)
- c. Explain briefly propagation of sound wave in compressible fluid with neat sketch. Write a expression relating speed of sound and temperature. (10 Marks)

Module-2

- 3 a. Explain briefly the following:
 - (i) Fundamental aerodynamic variable.
 - (ii) Wing planform geometry. (10 Marks)
- b. Explain the following :
 - (i) Aerodynamic forces and moments.
 - (ii) Centre of pressure.
 - (iii) Pressure coefficient.
 - (iv) Aerodynamic center. (10 Marks)

OR

- 4 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. Define Drag, what all the types of drag experienced by an aircraft, when flying at different mach regimes. (10 Marks)

Module-3

- 5 a. Explain Non lifting flow over a cylinder, with relevant expression. (10 Marks)
- b. What are Kutta-Joukowski conditions, how lift is generated in a rotating circular cylinder? (10 Marks)

OR

- 6 a. A fixed circular cylinder of infinite length is placed in a steady, uniform stream of an incompressible, non-viscous fluid. Assume that the flow is irrotational. Prove that the drag on the cylinder is zero. Neglect body forces. (08 Marks)
- b. Derive the classical thin airfoil theory for symmetric and cambered air foils. (12 Marks)

Module-4

- 7 a. State Helmholtz's vortex theorem and explain the vortex filament and the Biot-Savart law. (10 Marks)
- b. What is effective angle of attack? Explain the Down wash and Induced drag. (10 Marks)

OR

- 8 a. Explain in detail Prandtl's lifting line theory and its limitations. (10 Marks)
- b. Explain Extended lifting line theory of lifting surface theory, vortex lattice method for wings. (10 Marks)

Module-5

- 9 a. Explain the following :
 (i) Finite wing and Infinite wing
 (ii) Down wash and Induced drag (10 Marks)
- b. What is the effect of sweep in aircraft wing? Explain typical aerodynamic characteristics. (10 Marks)

OR

- 10 a. Write the effect of wing planform and aspect ratio. (06 Marks)
- b. What is critical Mach number and aspect ratio of wings? Write Aspect ratio of rectangular wing. (04 Marks)
- c. Explain briefly the source panel and vortex lattice method. (10 Marks)

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