CBCS SCHEME

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18AE/AS42

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 combered 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 Prandt'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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