CBCS SCHEME

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18AE/AS42

Fourth Semester B.E. Degree Examination, Dec.2023/Jan.2024
Aerodynamic – 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. An open circuit wind tunnel draws in an from the atmosphere through a well contoured nozzle. In the test section, where the flow is straight and nearly uniform a static pressure tap is drilled into the tunnel wall. A monometer connected to the tap shows that the static pressure within the tunnel is 45mm of water below atmosphere. Assume that air is incompressible and at 25°C, pressure is 100KPa (absolute). Calculate the velocity in the wind tunnel section. Density of water is 999kg/m^3 and characteristic gas constant for air is 287J/kg.k. **(10 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. **(06 Marks)**

b. Define and explain compressibility. **(10 Marks)**

c. Obtain the relation between stream function and potential function stating its inference. **(04 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. 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)**

c. Define the terms :
i) Centre of pressure
ii) Co-efficient of pressure
iii) Aerodynamic center. **(06 Marks)**

OR

4 a. With a neat sketch, explain in detail the airfoil nomenclature. **(08 Marks)**

b. With a neat sketch, explain the wing plan form geometry. **(06 Marks)**

c. Explain different types of drag. **(06 Marks)**

Module-3

5 a. Write short notes on the following :
i) Kutta condition
ii) Kevins circulation theorem. **(08 Marks)**

b. Obtain an expression for the following for a lifting flow over cylinder.
i) Stream function
ii) Location of stagnation points
iii) Pressure co-efficient
Also explain with a neat sketch, the location of stagnation points for different values of 'Γ'. **(12 Marks)**

OR

6 a. Derive the relation for lift co-efficient and lift slope for a cambered airfoil based on classical their airfoil theory. **(10 Marks)**

b. Consider a thin flat plate at 5 deg angle of attack. Calculate the :
i) Lift co-efficient
ii) Moment co-efficient about the leading edge
iii) Moment co-efficient about the quarter chord point
iv) Moment co-efficient about the trailing edge. **(10 Marks)**

Module-4

7 a. Explain and derive prandtl's lifting theory and its limitation. **(12 Marks)**

b. Explain the following :
i) Biot – Savart law
ii) Helmholtz's theorem
iii) Downwash. **(08 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. Explain in detail about lifting surface theory and vortex lattice method. **(10 Marks)**

Module-5

9 a. Explain the horse-shoe vertex system over a lifting wing. **(08 Marks)**

b. Discuss the advantages of swept wings in model airplane. **(04 Marks)**

c. Explain in detail about life enhancing devices. **(08 Marks)**

OR

10 a. Write short notes on the following :
i) Transonic area rule
ii) Supercritical airfoil. **(08 Marks)**

b. What is critical mach numbers and tip effects? **(04 Marks)**

c. Explain in detail about lift and drag divergence. **(08 Marks)**

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