CBCS SCHEME

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17AE/AS42

Fourth Semester B.E. Degree Examination, Aug./Sept. 2020
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. An open circuit wind tunnel draws in air from the atmosphere through a well contoured nozzle. In the test section, where the flow is straight and nearly uniform a static pressure top is drilled into the tunnel wall. A monometer connected to the tap shows that the static pressure within the tunnel is 45 mm of water below atmosphere. Assume that air is incompressible and at 25°C, pressure is 100 KPa (absolute). Calculate the velocity in the wind tunnel section. Density of water is 999 kg/m^3 and characteristic gas constant for air is 287 J/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 **(10 Marks)**

b. Define and explain compressibility. **(06 Marks)**

c. Obtain the relation between stream function and velocity 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 planform 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) Kelvin's 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 thin airfoil theory. **(10 Marks)**

b. Consider a thin flat plate at 5 degree 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 and (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 vortex system over a lifting wing. **(08 Marks)**

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

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

OR

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

b. What is critical Mach number and Tip effects? **(04 Marks)**

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

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