Hall Ticket No | | | | | | | | | | | Question Paper Code: AAEB10

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

B.Tech IV Semester End Examinations (Regular/Supplementary) - July, 2021

Regulation: R18

AERODYNAMICS

Time: 3 Hours **(AE)** **Max Marks: 70**

Answer FIVE Questions choosing ONE question from each module
(NOTE: Provision is given to answer TWO questions from any ONE module)
All Questions Carry Equal Marks
All parts of the question must be answered in one place only

MODULE – I

1. (a) Define source flow and hence derive expression for the stream function in terms of strength of source. **[7M]**
   (b) Prove that the velocity potential and the stream function intersect orhogonally in a flow field. **[7M]**
2. (a) Derive and signify the importance of Laplace equation in potential flows. **[7M]**
   (b) Consider the velocity field given by $u = y/(x^2 + y^2)$ and $v = -x/(x^2 + y^2)$. Calculate the equation of the streamline passing through the point (0, 5). Calculate the vorticity. **[7M]**

MODULE – II

3. (a) Explain the concept of starting vortex and hence explain how a starting vortex is responsible for generation of lift. **[7M]**
   (b) Apply thin airfoil theory to derive the expression for the slope of C_l V_s curve for a cambered airfoil. **[7M]**
4. (a) Explain Kutta conditions and write it in mathematical terms of strength of vortex sheet. **[7M]**
   (b) Consider an NACA 2412 airfoil with a chord of 0.64 m in an airstream at standard sealevel conditions. The freestream velocity is 70 m/s. The lift per unit span is 1254 N/m. Calculate the strength of the steady-state starting vortex. **[7M]**

MODULE – III

5. (a) What is Prandtl's lifting line theory? Apply Prandtl lifting line theory to calculate coefficient of induced drag over an elliptical wing. **[7M]**
   (b) Consider a finite wing with an aspect ratio of 8 and a taper ratio of 0.8. The airfoil section is thin and symmetric. Calculate the lift and induced drag coefficients for the wing when it is at an angle of attack of 5^0. Assume that $\delta = \tau$ **[7M]**
6. (a) Discuss the application of source panel method for prediction of non-lifting flow over a body of arbitrary shape. **[7M]**
   (b) Calculate the pressure coefficient distribution around a circular cylinder using source panel technique. **[7M]**

MODULE – IV

7. (a) What are the affected parameters due to wing-body interference?Explain the concept of interference effect and its role in generation of drag. **[7M]**

   (b) How the propeller effects can be minimized? Interpret the effect of propeller on aerodynamics efficiency of wing. **[7M]**

8. (a) Give the example of flow singularity.Discuss the role of method of singularity in theoretical potential flows. **[7M]**

   (b) Derive the equation of coefficient of pressure for lateral flow past slender body of revolution. **[7M]**

MODULE – V

9. (a) Derive expression for the local skin-friction coefficient for the incompressible laminar flow over a flat plate **[7M]**

   (b) Explain the transition of laminar boundary layer to turbulent boundary layer.Which is more preferable? Give reason for your answer. **[7M]**

10. (a) Compare the flow physics of viscous flow with inviscid flow and hence explain the concept of boundary layer. **[7M]**

    (b) A flat plate of 0.6 m chord at zero incidence in a uniform airstream of 45 m/s Estimate
    i) The displacement thickness at the trailing edge, and ii) The overall drag coefficientof the plate. **[7M]**

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