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10AE63

Sixth Semester B.E. Degree Examination, June / July 2014
Aerodynamics – II

Time: 3 hrs. Max. Marks:100

Note: *Answer FIVE full questions, selecting at least TWO questions from each part.*

PART – A

1 a. Explain vertex panel and derive an expression for total surface velocity induced at its control point, deduce an expression for total circulation and lift per unit for lifting flow over an arbitrary body. **(10 Marks)**

b. Derive an expression for normal velocity, tangential induced velocity and pressure co-efficient at its control point, using source panel distribution method over the surface of a body of arbitrary shape. **(10 Marks)**

2 a. Derive an expression for lift circulation and induced drag co-efficient of circulation strength $\Gamma(y)$ for a finite wing, through Prandtl's classical lifting line theory. **(10 Marks)**

b. Consider a rectangular wing with an aspect ratio of b, an induced drag factor is 0.055 and a zero lift angle of attack -2°. At an angle of attack 3.4°, the induced drag co-efficient for this wing is 0.01. Calculate the induced drag co-efficient for a similar wing (a rectangular wing with same airfoil section) at the same angle of attack, but with an aspect ratio of 10. Assume that the induced factors of drag and the lift slope δ, and τ respectively, are equal to each other. (Consider $\delta = 0.0105$ for AR = 10) **(10 Marks)**

3 a. Derive Prandtl-Glauret compressibility correction for compressible and incompressible flow relation for expressions C_P, C_m and C_L. **(10 Marks)**

b. Explain the characteristics of transonic airfoils. **(06 Marks)**

c. The critical Mach number of an airfoil is 0.62. Find the critical pressure co-efficient. (Assume $\gamma = 1.4$) **(04 Marks)**

4 a. Explain the characteristics of super critical airfoil. **(06 Marks)**

b. The critical Mach number of an airfoil is 0.6 and at a given point on the airfoil, the pressure co-efficient is -0.3 at very low speed. Calculate C_p at that point. **(04 Marks)**

c. Explain the following with a neat sketches:
i) Drag-divergence mach number and sound barrier. **(10 Marks)**
ii) Area rule.

PART – B

5 a. Write short notes on any two of the following:
i) Formation of flight.
ii) Influence of downwash on tail plane.
iii) Ground effects on aircraft during take-off and landing. **(10 Marks)**

b. Calculate the induced co-efficient of drag for a wing 40 m^2 and span of 8 m while for wing of area 60 m^2 and span is 10 m, the induced drag co-efficient is 0.015. (Other conditions remain same). **(04 Marks)**

c. Consider a finite wing with an aspect ratio 8 and taper ratio of 0.8. The airfoil section is thin and symmetric. Calculate the lift and induced drag co-efficient for the wing, when angle of attack is at 5°. (Assume $\delta = 0.055$ and $\delta = \tau$) **(06 Marks)**

6 a. What are the different types of small perturbation flows? Briefly explain with relevant sketches. **(08 Marks)**

b. Describe the subsonic flows past an axially symmetric body of revolution with relevant sketches. **(12 Marks)**

7 a. List advantages of flaps and slots with neat sketch and briefly explain their advantages for an aircraft at flight. **(10 Marks)**

b. Describe the aerodynamic characteristics of swipt wings at supersonic speeds with relevant graphs and sketches. **(10 Marks)**

8 a. What is the boundary layer theory? Explain laminar, turbulent boundary layer and transition over a flat plate at low speeds. **(10 Marks)**

b. Find the displacement, momentum and energy thickness for the velocity distribution in the boundary layer given by, $\frac{u}{U} = \frac{y}{\delta}$ where u is the flow velocity at a distance (y) from the solid boundary, u = U at y = δ, where δ is the boundary layer thickness. Also calculate the ratio of momentum thickness to displacement thickness. **(10 Marks)**

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