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10AE63

Sixth Semester B.E. Degree Examination, Dec.2017/Jan.2018
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. What is a source sheet? Explain. Derive the velocity potential at a point P at a distance r from a source sheet of strength λ per unit length. **(10 Marks)**

b. Consider lifting flow over an arbitrary body and derive an expressions for total surface velocity induced at the 'i^{th} control point employing vertex panel method and application of Kutta condition. **(10 Marks)**

2 a. Derive fundamental equation of Prandtl's Lifting line theory. **(10 Marks)**

b. State Biot-Savart law and derive velocity induced at a particular point due to semi-infinite vertex. **(10 Marks)**

3 a. Obtain linearized potential flow equation for flow over airfoil using small perturbation theory. **(12 Marks)**

b. Briefly explain Boundary condition in consistent with linearized velocity potential equation. **(04 Marks)**

c. For a thin symmetric airfoil in an incompressible flow, the coefficient of lift is $C_l = 2\pi\alpha$, where α is angle of attack. Find the increase in co-efficient of lift curve slope when Mach number is increased to 0.7. **(04 Marks)**

4 a. What is critical Mach number? Derive an expression for critical pressure coefficient in terms of critical Mach number. **(10 Marks)**

b. Derive an expression for speed of sound for isentropic condition. **(10 Marks)**

PART – B

5 a. Briefly explain: (i) Formation flight. (ii) Ground effects. **(10 Marks)**

b. An aeroplane of weight 'W' and span '2s' is flying horizontally near the ground at altitude 'h' and speed 'V'. Estimate the reduction in drag due to ground effect. If $W = 22\times10^4$ N, h = 15.2 m, s = 13.7 m, V = 45 m/s. Calculate the reduction in Newtons. **(10 Marks)**

6 a. Derive pressure coefficient using small perturbation values. **(10 Marks)**

b. Describe the subsonic flow past an axially symmetric body of revolution at zero-incidence. **(10 Marks)**

7 a. What is a swept wing? Bring out the aerodynamic characteristics of swept wing, with relevant graphs and sketches. **(10 Marks)**

b. What are High Lift devices? List them and explain their effects an aerodynamic characteristics with suitable graphs. **(10 Marks)**

8 a. Derive the Navier-stokes equation for two-dimensional flow. **(10 Marks)**

b. Briefly explain about Boundary-layer properties. **(10 Marks)**

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