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10AE63

Sixth Semester B.E. Degree Examination, Dec.2014/Jan.2015

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. 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 expression for total surface velocity induced at the i^{th} control point employing vortex panel method. **(10 Marks)**

2 a. Explain the following:
i) Downwash and induced drag
ii) Biot-Savarth law
iii) Helmholtz's vortex theorem **(06 Marks)**

b. Explain and derive Prandtl's lifting line theory and its limitations. **(06 Marks)**

c. Derive expressions for lift, induced drag and downwash for elliptic lift distribution. **(08 Marks)**

3 a. Derive the governing velocity potential equation for an inviscid, compressible, irrotational subsonic flow over a body immersed in a uniform stream. **(10 Marks)**

b. Derive and explain the Prandtl Glauset compressibility correction formula. **(06 Marks)**

c. At a given point on the surface of an airfoil, the C_p is -0.3 at very low speeds. If the free stream mach no. is 0.6, calculate C_p at this point? **(04 Marks)**

4 a. Define: i) Mach waves and expansion waves, ii) Normal and oblique shocks. **(04 Marks)**

b. What is critical mach no.? Derive an expression for critical pressure coefficient in terms of critical mach no.? **(10 Marks)**

c. Explain: i) Drag-Divergence Mach number, ii) Sound barrier and iii) Transonic area rule. **(06 Marks)**

PART – B

5 a. Explain in detail the influence of downwash on tail plane. **(08 Marks)**

b. Explain with figure the formation flying effect and ground effect. **(06 Marks)**

c. Prove that for a monoplane a rotational formula for the downwash, in degrees at the tail plane is $\varepsilon = \text{constant} \times \frac{CL}{AR}$. Determine the numerical value of the constant for a point on the center line of the machine 2s/3 behind the centre of pressure, s being the semi-span. **(06 Marks)**

6 a. What are cylindrical coordinates used for bodies of revolution and velocity potential in cylindrical coordinates? **(06 Marks)**

b. Derive linearised supersonic pressure coefficient formula. **(14 Marks)**

7 a. What are swept back wings? How the performance of an airplane is improved by the application of swept back wing's concept? **(10 Marks)**

b. What are high lift devices? Explain. Describe the functions of different types of flaps with figures. **(10 Marks)**

8 With neat sketch, describe the process of flow over a flat plate, also stating the assumptions explain the phenomenon of turbulent boundary layer properties over the same flat plate at low speeds. **(20 Marks)**

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