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10AE63

Sixth Semester B.E. Degree Examination, Aug./Sept. 2020
Aerodynamics – II

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Calculate the pressure coefficient distribution around a circular cylinder using the source Panel technique. **(16 Marks)**

b. Explain the difference between source panel and vortex panel methods. **(04 Marks)**

2 a. Derive the expression for the induced AOA and induced drag coefficient using elliptical lift distribution. **(10 Marks)**

b. Derive an expression for lift coefficient and induced drag coefficient in terms of circulation strength $\Gamma(y)$ for a finite wing using through general lift distribution. **(10 Marks)**

3 a. Derive the velocity potential equation for an inviscid, compressible, irrotational, subsonic flow over a body immersed in a uniform flow. **(12 Marks)**

b. At a given point on the surface of an airfoil, the pressure coefficient is 0.3 at very low speeds. If the free stream is 300 m/s at standard sea level conditions, calculate the pressure coefficient at the same point at this speed. **(04 Marks)**

c. The lift coefficient for a thin, symmetric airfoil in an incompressible flow is $C_L = 2\pi\alpha$. Calculate the compressible lift coefficient at a flight velocity at sea level condition is $V_\infty = 248$ m/sec. **(04 Marks)**

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

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

c. Explain :
i) Drag-Divergence Mach number
ii) Sound barrier
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. Explain the advantages of swept sock wings in military airplanes with neat sketches. **(10 Marks)**

b. Explain with a neat sketch 4 flaps and slots, also discuss about their performance characteristics with relevant graphs. **(10 Marks)**

8 a. Define total drag and discuss the boundary layer flow transition over a flat plate and an airfoil. **(10 Marks)**

b. For velocity profile for laminar boundary layer,

$$\frac{U}{U} = 2\left(\frac{y}{\delta}\right) - \left(\frac{y}{\delta}\right)^2.$$

Determine:

i) Displacement thickness

ii) Energy thickness

iii) Momentum thickness **(10 Marks)**

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