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10AE63

Sixth Semester B.E. Degree Examination, June/July 2017
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. 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 and derive continuity, momentum and energy equation for normal shock waves. **(10 Marks)**

b. Consider an airplane flying at a velocity of 250 m/s. Calculate it's Mach number if it is flying at a standard altitude of (i) sea level (ii) 5 km (iii) 10 km. Assume T_∞ at sea level = 288 K, T_∞ at 5 km = 255.7 and T_∞ at 10 km = 223.3 **(06 Marks)**

c. A supersonic airplane is flying at Mach 2 at an altitude of 16 km. Assume the shock wave pattern from the airplane quickly coalesces into mach wave that intersects the ground behind the airplane, causing a 'sonic boom' to be heard by a bystander on the ground. At the instant the sonic boom is heard, how far ahead of the bystander is the airplane? **(04 Marks)**

PART – B

5 Write short notes on the following:

a. Simplified horse shoe vortex model.

b. Formation of flight.

c. Influence of downwash on tail place.

d. Ground effects. **(20 Marks)**

6 Deduce the following:

a. $-\frac{\tau+1}{V_\infty}\phi_x\phi_{xx} + \phi_{rr} + \frac{1}{r}\phi_r = 0$ **(10 Marks)**

b. $R(x)\left(\frac{v_r}{v_\infty + u}\right)_c \approx \frac{(rv_r)_0}{v_\infty} = R(x)\frac{dR(x)}{dx}$ **(10 Marks)**

7 a. What are high lift devices? List them and explain their effects on aerodynamic characteristics. **(10 Marks)**

b. Discuss the advantages of swept wings in modern airplanes. **(10 Marks)**

8 a. Derive and illustrate with a neat sketch of the boundary layer properties over a flat plate considering viscous flow. **(12 Marks)**

b. Derive the Navier-stokes equation for an unsteady, compressible, three-dimensional viscous flow. **(08 Marks)**

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