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10AE63

Sixth Semester B.E. Degree Examination, June/July 2016

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 source panel methods for non-lifting flows over a arbitrary bodies to find the pressure coefficient at i^{th} control point. Also find normal and tangential velocity. **(10 Marks)**

b. Explain vortex panel method for lifting flow over arbitrary bodies to find lift per unit span at j^{th} control point. **(10 Marks)**

2 a. The circulation distribution over a finite wing is of elliptic form $\Gamma_0 = \Gamma_0\sqrt{1-\left(\frac{2y}{b}\right)^2}$, where $\frac{b}{2}$ is the semi span of wing. Obtain from the closed form of expression, the induced angle of attack and induced drag coefficient. **(10 Marks)**

b. Discuss the effects of induced drag on downwash using finite wing theory horse shoe vortex system. **(10 Marks)**

3 a. Explain the assumption of linearized velocity potential equation and derive an expression for pressure coefficient using linearized velocity potential equation for an invisid, compressible, irrotational flow. **(10 Marks)**

b. Explain the characteristics of transonic airfoils. **(05 Marks)**

c. If critical Mach number of an airfoil is 0.8. Calculate the value of $\frac{p}{p_\infty}$ at the minimum pressure point when $M_\infty = 0.8$. **(05 Marks)**

4 a. Explain a NACA0012 airfoil at zero angle of attack $C_{po} = -0.43$. Estimate the critical mach number by graphical method. **(10 Marks)**

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

PART – B

5 a. Briefly explain the effects of downwash on:
i) Formation of flying
ii) Ground effects on aircraft **(10 Marks)**

b. A twin jet execution transport aircraft with zero angle of attack $\alpha_{L=0} = -2°$, lift slope of airfoil section is 0.1/deg. The lift efficiency factor is 0.004 and wing AR = 7.96. At cruising condition, calculate the angle of attack of the airplane. (At cruise $C_L = 0.21$). **(10 Marks)**

6 a. Enlist the different types of small perturbation flows and briefly explain each with a neat sketch. **(10 Marks)**

b. Describe the subsonic flows past an axially symmetric body of revolution with relevant sketches. **(10 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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