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10AE63

Sixth Semester B.E. Degree Examination, Dec.2018/Jan.2019
Aerodynamics - II

Time: 3 hrs.

Max. Marks:100

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

PART - A

- 1 a. Calculate the pressure coefficient distribution around a circular cylinder using the source panel technique. (12 Marks)
 b. Derive the relation for lift per unit span, using the vortex panel method. (08 Marks)
- 2 a. Derive the expression for induced angle of attack and induced drag coefficient using elliptical distribution. (10 Marks)
 b. Derive the expression for induced drag coefficient using general lift distribution. (10 Marks)
- 3 a. Obtain the expression $(1 - M_\infty^2) \frac{\partial^2 \hat{\phi}}{\partial x^2} + \frac{\partial^2 \hat{\phi}}{\partial y^2} = 0$. (10 Marks)
 b. Obtain the expression $C_p = \frac{C_{p.o}}{\sqrt{1 - M_\infty^2}}$. (10 Marks)
- 4 a. Consider an airplane flying at a velocity of 250 m/s. Calculate its Mach number if it is flying at a standard altitude of i) Sea level ii) 5km iii) 10km. Assume for 5km, $T_\infty = 255.7$, for 10km, $T_\infty = 223.3$. (08 Marks)
 b. Consider a normal shock wave in air where the upstream flow properties are $u_1 = 680$ m/s, $T_1 = 288$ K and $P_1 = 1$ atm. Calculate the velocity, temperature and pressure downstream of the shock. [Assume $\frac{P_2}{P_1} = 4.5$; $\frac{T_2}{T_1} = 1.687$; $M_2 = 0.5774$]. (08 Marks)
 c. Consider the Lockheed SR-71 blackbird flying at a standard altitude of 25km. The pressure measured by a Pitot tube on this airplane is 3.88×10^4 N/m². Calculate the velocity of the airplane. (04 Marks)

PART - B

- 5 Write short notes on the following:
 - a. Formation of flight (06 Marks)
 - b. Influence of downwash on tail plane (06 Marks)
 - c. Ground effects. (08 Marks)
- 6 a. What are cylindrical coordinates used for bodies of revolution and velocity potential along them? (08 Marks)
 b. Explain with a neat sketch, the boundary conditions for a 2D axially symmetric body. (06 Marks)
 c. Explain how do you obtain solution for a slender cone. (06 Marks)

- 7 a. What are high lift devices? List them and explain their effects on aerodynamic characteristics with suitable graphs. (10 Marks)
b. Discuss the advantages and disadvantages of Forward-Swept wings. (10 Marks)
- 8 a. Derive Blasius solution for an incompressible flow over a flat plate. (10 Marks)
b. Derive the Navier-Stokes equation for 3-D flow, in partial differential and non-conservation form. (10 Marks)
