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10AE54

Fifth Semester B.E. Degree Examination, Dec.2017/Jan.2018
Aerodynamics - I

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Derive an expression for One – dimensional form of momentum equation. State the Bernoulli's equation assumptions. **(10 Marks)**

b. An open circuit wind tunnel draws in air from the atmosphere through a well contoured nozzle. In the test section, where the flow is straight and nearly uniform, a static pressure top is drilled into the tunnel wall. A monometer connected to the tap shows that the static pressure within the tunnel is 45 mm of water below atmosphere. Assume that air is incompressible and at 25^0C, Pressure is 100 kPa (absolute). Calculate the velocity in the wind tunnel section. Density of water is 999kg/m^3 and characteristic gas constant for air is 287 J/kg K. **(10 Marks)**

2 a. Write short notes on :
i) Langrangian method ii) Eulerian method. **(04 Marks)**

b. Derive the integral and differential form of energy equation applied to a finite volume fixed in space flow model. **(10 Marks)**

c. Consider the velocity field, given by
$u = \frac{Y}{(x^2+y^2)}$ and $v = \frac{X}{(x^2+y^2)}$. Calculate the vorticity. **(06 Marks)**

3 a. Derive an expression for axial force co-efficient (C_a) and normal force co-efficient (C_n) of an airfoil. **(10 Marks)**

b. Explain the following modified NACA Four & Five digit series :
i) 1 – Series : NACA 16-123.
ii) 6 – Series : NACA $61_2 - 315$.
iii) 7 – Series : NACA 712A 315. **(10 Marks)**

4 a. Consider the nonlifting flow over a circular cylinder. Calculate the location on the surface of the cylinder where the surface pressure equals the free stream pressure. **(10 Marks)**

b. Prove that resultant stream lines will be circular arc passing through source and sink. **(10 Marks)**

PART – B

5 a. Consider the lifting flow over a circular cylinder. The lift coefficient is 5, calculate the location of the stagnation points and the points on the cylinder where the pressure equals free stream static pressure. **(10 Marks)**

b. Consider a lifting flow over a circular cylinder. Derive the expression for the lift per unit span. Also discuss the location of stagnation points for various 'Γ'. **(10 Marks)**

6 a. Derive the relation for lift coefficient and lift slope for a cambered airfoil based on Classica thin airfoil theory. **(10 Marks)**

b. Consider a thin flat plate at 5 deg. angle of attack. Calculate the
i) lift coefficient ii) moment coefficient about the leading edge iii) momen coefficient about the quarter chord point and iv) moment coefficient about the trailing edge. **(10 Marks)**

7 a. Explain the boundary layer, with a relevant sketch. Derive the expression for
i) Displacement thickness ii) Momentum thickness. **(10 Marks)**

b. Derive the Blasius equation for incompressible flow over a flat plate. **(10 Marks)**

8 a. Explain the construction and working of various components in a typical subsonic open and closed circuit wind tunnel, with neat sketch. **(10 Marks)**

b. Explain how the drag will be determined using low speed wind tunnel by wake survey **(10 Marks)**

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