B.Tech. AEROSPACE ENGINEERING (BTAE)

Term-End Examination

December, 2016

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BAS-012 : AERODYNAMICS – I

Time : 3 hours   *Maximum Marks : 70*

Note : *Attempt any **seven** questions. All questions carry equal marks. Use of scientific calculator is permitted.*

1. (a) Define the following :
    (i) Centre of Pressure
    (ii) Aerodynamic Centre
    (iii) Jet Flap
    (iv) Stall Condition

    (b) What is the difference between Euler's model and Navier-Stokes model of equations ? Write the generic form of Navier-Stokes equations.   *5+5*

2. (a) Briefly explain the flow in a C-D nozzle with the help of a neat sketch.

    (b) What are the characteristics of a vortex flow ? State and prove the Kutta-Zhukovsky theorem.   *5+5*

3. (a) Draw a neat sketch of a supersonic wind tunnel circuit and explain the function of each component.

(b) Discuss lift on rotating cylinder in uniform flow. *5+5*

4. (a) How does Van der Waals equation differ from ideal gas equation ? Explain.

(b) A point source is a point where an incompressible fluid is imagined to be created and sent out evenly in all directions. Determine its velocity potential and stream function. *5+5*

5. (a) If the stream function for steady flow is given by $\psi = y^2 - x^2$, determine whether the flow is rotational or irrotational. Then determine the velocity potential ϕ.

(b) The stream function for a two-dimensional flow is given by $\psi = 2xy$. Calculate the velocity at the point P(2, 3). Also find the velocity potential function. *5+5*

6. (a) Distinguish between the following :

(i) Steady and Unsteady flow

(ii) Rotational and Irrotational flow

(b) In a two-dimensional incompressible flow, the fluid velocity components are given by

$$u = x - 4y \text{ and } v = -y - 4x.$$

Show that the velocity potential exists and determine its form. Also find the stream function. *5+5*

7. (a) Differentiate between the following :

(i) Streamlined body and Bluff body

(ii) Friction drag and Pressure drag

(b) A flat plate 2 m × 2 m moves at 40 km/hour in stationary air of density 1·25 kg/m^3. If the coefficient of drag and lift are 0·2 and 0·8 respectively, find

(i) the lift force,

(ii) the drag force,

(iii) the resultant force, and

(iv) the power required to keep the plate in motion. *5+5*

8. (a) Define Doublet. Draw its streamlines.

(b) How are streamlines and equipotential lines related to each other ? Explain. *5+5*

9. Write short notes on any **two** of the following : 2×5=10

(a) Magnus Effect

(b) Boundary Layer

(c) Pitching Moment

(d) Mach Number