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BAS-012

B.Tech. AEROSPACE ENGINEERING (BTAE)

00172

Term-End Examination

December, 2017

BAS-012 : AERODYNAMICS - I

Time : 3 hours *Maximum Marks : 70*

Note : *(i) Attempt **any ten** questions.*

*(ii) **All** questions carry **equal** marks*

*(iii) Use of scientific calculator is **permitted.***

1. (a) What is flow separation ? What causes it ? **3+4**

(b) Why is flow separation in flow over cylinders delayed when the boundary layer is turbulent ?

2. (a) Determine the density, specific gravity, and mass of the air in a room whose dimensions are $4m \times 5m \times 6m$ at 100 kPa and 25°C. Given Gas Constant of air, $R = 0.287$ kPa m^3/kg K. **3+4**

(b) How does the dynamic viscosity of liquid and gases vary with temperature ?

3. (a) A steady two-dimensional velocity field is given by $V = (1.35 + 2.78x - 0.896y)\hat{i} + (3.45x + Cx - 2.78y)\hat{j}$. Calculate constant C such that the flow is irrotational. **3+4**

(b) The u velocity component of a steady two-dimensional incompressible flow field is $u = 3ax^2 - 2bxy$, where a and b are constant. Velocity component v is unknown. Generate an expression for v as a function of x and y.

4. What are wind tunnels ? Explain the difference between subsonic and supersonic wind tunnels, using neat sketches. 7

5. Define the "continuity equation". Obtain an expression for continuity equation for a three-dimensional steady incompressible flow. 7

6. (a) Define **any three** of the following : 3+4
   (i) Wake
   (ii) Centre of pressure
   (iii) Turbulent flow
   (iv) Stall condition

   (b) Differentiate between the followings **(any two) :**
   (i) Stream function and Velocity potential function
   (ii) Compressible and Incompressible flows
   (iii) Steady and Unsteady flows.

7. A stream function of a two-dimensional flow is given by $\psi = 8xy$. Calculate the velocity at a point P(4,5). Find also the velocity potential function ϕ. 7

8. State Bernoulli's theorem for steady flow of an incompressible fluid. Derive an expression for Bernoulli's theorem from first principle and state the assumption made for such a derivation. 7

9. A flat plate 1.5 m × 1.5 m moves at 50 km/hour in stationary air of density 1.15 kg/m^3. If the co-efficient of drag and lift are 0.15 and 0.75 respectively, determine : 7

(a) The lift force

(b) The drag force

(c) The resultant force, and

(d) The power required to keep the plate in motion.

10. A two-dimensional steady flow has velocity components $u = y$, $v = x$. Show that the streamlines are rectangular hyperbolas $x^2 - y^2 = \text{constant}$. 7

11. Prove that the stream function satisfies the Laplace equation for irrotational, incompressible flow in cartisian co-ordinate system. 7

12. Answer **any two** of the following questions in brief : 2x3½=7

(a) What is conformal transformation ?

(b) State Kutta-JouKowski theorem.

(c) What is meant by Washin and Washout for wings ?

(d) Explain different methods used to avoid boundary layer separation.