

**B.Tech. AEROSPACE ENGINEERING  
(BTAE)**

**Term-End Examination, 2019**

**BAS-012 : AERODYNAMICS-I**

**Time : Three Hours]**

**[Maximum Marks : 70**

---

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

---

1. (a) Differentiate between Compressible and incompressible flows. [5]

(b) The stream function for a two-dimensional flow is given by :

$$\psi = 2xy$$

Calculate the velocity at the point  $P(2, 3)$ . Find the value of velocity potential. [5]

2. (a) (i) What is Conformal Transformation ?

(ii) State Kutta-Joukowski theorem. [5]

- (b). The velocity vector for a steady incompressible flow is given by :

$$V = (6xt + yz^2)i + (3t + xy^2)j + (xy - 2xyz - 6tz)k$$

Verify whether the continuity equation is satisfied.

[5]

3. (a) Derive continuity equation in 3-D Cartesian Coordinates. [5]

- (b) In a two-dimensional flow :

$$\psi = 3xy$$

Prove that the flow is irrotational. Also determine the corresponding velocity potential. [5]

4. (a) What are Wind Tunnels ? Explain the difference between Subsonic and Supersonic wind tunnels, using neat sketches. [5]

- (b) Define **any five** of the following : [5]

(i) Ideal fluid

(ii) Doublet flow

- (iii) Circulation
- (iv) Turbulence
- (v) Super Critical Airfoil
- (vi) Magnus effect

5. (a) State and explain the Bernoulli's equation for incompressible flow. [5]

(b) Derive the fundamental equation for Thin Airfoil Theory. State the assumptions made. [5]

6. (a) Derive the expression for vorticity in terms of the velocities in  $x$ ,  $y$  and  $z$  directions respectively. [5]

(b) The velocity components for 2-D flow are given as : [5]

$$u = 3x + 4y$$

$$v = 2x - 3y$$

Show whether the flow is rotational or irrotational.

7. (a) Describe the construction of a pitot tube with the help of a neat diagram. Which physical quantity can be measured by a pitot tube and how it can be measured ? [5]
- (b) Explain Subsonic, Transonic, Supersonic and Hypersonic flows in terms of Mach no. Also give neat sketches with Mach no regimes for each of them. [5]
8. Write short notes on **any two** of the following : [2x5=10]
- (a) Stall condition
- (b) Aircraft flaps
- (c) Convergent-Divergent nozzle
- (d) Finite wing

----- x -----