

Time : 3 hrs

Maximum Marks : 100

Answer One Question from Each Unit  
All Questions Carry Equal Marks

UNIT-I

1. a) Discuss about velocity of fluid at a point and explain about local and particle rates of change.
- b) Derive Euler's equations of motion and write their vector and Cartesian forms.

(OR)

2. a) Derive the equation of continuity and test whether the motion specified by  $q = \frac{k^2(x\bar{j} - y\bar{i})}{x^2 + y^2}$ , where  $k$  is a constant is a possible motion for an incompressible fluid. If so, determine the equations of the streamlines.
- b) With usual notation derive the Bernoulli's equation for fluid motion and explain about one of its application.

UNIT-II

3. a) i) Discuss about sources, sinks and doublets in three-dimensional flow.
- ii) A three -dimensional doublet of strength  $\mu$  whose axis is in the direction  $OX$  distant  $a$  from the rigid plane  $x = 0$  which is the sole boundary of liquid of density  $\rho$ , infinite in extent. Find the pressure at a point on the boundary distant  $r$  from the doublet, given that the pressure at infinity is  $p_\infty$ . Show that the pressure on the plane is least at a distance  $a\sqrt{5/2}$  from the doublet.
- b) Discuss about Stoke's stream function for axisymmetric flows in detail.

(OR)

4. a) i) Explain two-dimensional flows in detail.
- ii) Define the stream function and discuss about its physical significance.
- b) A two-dimensional flow field is given by  $\psi = xy$ . i) Show that the flow is irrotational ii) Find the velocity potential iii) Verify that  $\psi$  and  $\phi$  satisfy the Laplace equation iv) Find the streamlines and potential lines.

### UNIT-III

5. a) State and prove the Milne-Thomson circle theorem. Also write some of its applications.  
b) Explain stress components in a real fluid and establish the relations between Cartesian components of stress.

**(OR)**

6. a) Explain about the rate of strain quadric and its properties.  
b) Establish the relation between stress and rate of strain.

### UNIT-IV

7. a) Derive the Navier-Stokes equations of motion of a viscous fluid and Express them in Cartesian form.  
b) Discuss about steady motion between parallel planes.

**(OR)**

8. a) Explain about Poiseuille flow in detail.  
b) State and prove the uniqueness theorem and discuss about the flow in tube having uniform elliptic cross-section.

### UNIT-V

9. a) Explain about diffusion of vorticity and energy dissipation due to viscosity.  
b) Discuss about steady flow past a fixed sphere.

**(OR)**

10. a) Write about dimensional analysis and Reynolds number.  
b) Explain in detail about Prandtl's boundary layer.

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