

Duration: 3hrs

[Max Marks:80]

- N.B. : (1) Question No 1 is Compulsory.
(2) Attempt any three questions out of the remaining five.
(3) All questions carry equal marks.
(4) Assume suitable data, if required and state it clearly.

- 1 Attempt any FOUR [20]
 - a Explain Newtonian and non-Newtonian Fluids [5]
 - b Explain velocity potential function and stream function. [5]
 - c What are the Applications of Bernoulli's equation in Orifice meter, Venturi meter, Rotameter and Pitot tube [5]
 - d Define Reynolds number. Explain critical Reynolds number for flat plate and pipe conduit. [5]
 - e Explain various Major and Minor losses for flow through pipe [5]
 - f Explain Streamlined and bluff bodies
- 2 a The flow field is given by $V = xyi + 2yzj - (yz + z^2)k$ [10]
 - i) Show that it represents a possible 3-D steady incompressible continuous flow
 - ii) Is this flow rotational or irrotational? If rotational determine at the point (2,4,6)
 - a) angular velocity, b) vorticity, c) shear strain, and d) Dilatency
- b Derive an expression for total pressure and centre of pressure for a vertically immersed surface. [10]
- 3 a What is venturimeter? Derive expression of discharge through venturimeter. [10]
- b 360 lit/sec of water is flowing in pipe. The pipe is bent by 120° . The pipe bend measures 360 mm x 240 mm and volume of the bend is 0.14 m^3 . The pressure at the entrance is 73 KN/m^2 and the exit is 2.4m above the entrance. Find the direction and magnitude of resultant force. [10]
- 4 a A liquid of viscosity of 0.9 poise is filled with horizontal plates 10 mm apart. If the upper plate is moving at 1 m/s with respect to the lower plate which is stationary and pressure difference between two sections 60m apart is 60 kN/m^2 . Determine i) The velocity distribution ii) The discharge per unit width iii) The shear stress on upper plate. [10]
- b Derive Euler's equation of motion in rectangular Cartesian co-ordinate system and from this derive Bernoulli's Equation for liquid. State assumptions made in the derivation of Bernoulli's Equation [10]
- 5 a Derive the Hagen-poiseuille Equation. [10]
- b Water is flowing through a pipe having diameter 600 mm and 400 mm at the bottom and upper end respectively. The intensity of pressure at the bottom end is 350 kN/m^2 and the pressure at upper end is 100 kN/m^2 . Determine the difference in datum head if the rate of flow through the pipe is 60 litre/sec. [10]

- 6 a Two reservoirs with a difference in elevation of 15m are connected by the three pipes in series. The pipes are 300 m long of diameter 30 cm, 150 m long of 20cm diameter and 200 m long of 25 cm diameter respectively. The friction factors for three pipes are 0.018, 0.020 and 0.019 respectively and which account for friction and all losses. **Determine** the flow rate in lit/sec. The loss of coefficient for sudden contraction for dia.30 cm to 20 cm is equal to 0.24. [10]

- b Using the laminar boundary velocity distribution: [10]

$$\frac{u}{U} = \frac{3}{2} \left(\frac{y}{\delta} \right) - \frac{1}{2} \left(\frac{y}{\delta} \right)^3$$

(i) Determine boundary layer thickness in terms of Re

(ii) Check if boundary layer separation occurs
