Paper / Subject Code: 41222 / Fluid Mechanics

SE Sem IV (C Scheme) R-2019 "Mechanical" Dec 2022

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.

Attempt any FOUR [20]

1 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 $V = xyi + 2yz\,j - (yz+z^2)\,k$ [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 120^0. 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

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