Total No. of Questions : 8]

SEAT No. :

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# [6179]-323
## S.E. (Automobile and Mechanical)
## FLUID MECHANICS
## (2019 Pattern) (Semester-IV) (202049)

*Time : 2½ Hours]* *[Max. Marks : 70*

***Instructions to the candidates :***

1) ***Answer Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7or Q8.***
2) ***Neat diagrams must be drawn wherever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Use of electronic pocket calculator is allowed.***
5) ***Assume suitable data, if necessary.***

***Q1)*** a) Distinguish between : **[4]**

i) Uniform and Non-uniform Flow

ii) Laminar & Turbulent Flow

b) Derive a generalized continuity equation for three-dimensional flow field. **[6]**

c) Given that $u = x^2 - y^2$ and $v = -2xy$, determine the stream function and potential function for the flow. **[7]**

OR

***Q2)*** a) Explain the following properties with their mathematical properties: **[4]**

i) Velocity Potential

ii) Stream function

b) Prove that the velocity potential line and stream line are orthogonal to each other. **[6]**

c) The stream function for a two-dimensional flow is given by $\psi = x^2 - y^2$. Calculate the velocity and acceleration at P (2,2). **[7]**

***P.T.O.***

***Q3)*** a) What is Pitot tube? How Pitot Static Tube is used measure velocity of flow at any point in a pipe or channel? **[4]**

b) State Bernoulli's Theorem for a steady flow of an incompressible fluid flow. Derive Bernoulli's equation from Euler's equation along the stream line. Also, state the assumptions made while deriving it. **[6]**

c) Crude oil of viscosity 0.96 poise flows through a circular pipe of diameter 15 cm and the length of pipe is 15cm. Determine the difference in pressure at the two ends of the pipe if discharge is 4 lit/s. Also determine shear stress at the pipe wall. **[8]**

OR

***Q4)*** a) What are the characteristics of laminar flow? **[4]**

b) Prove that for steady laminar flow through pipe, the velocity distribution across the section is parabolic and the average velocity is half the maximum velocity. **[6]**

c) A vertical venturi meter carries a liquid of relative density 0.8 and has inlet and throat diameter of 150mm and 75mm. The pressure connection at throat is 150mm above that at the inlet. If the actual rate of flow is 40lit/s and the $C_d$ is 0.96, Calculate the pressure difference between inlet and throat in $N/m^2$. **[8]**

***Q5)*** a) Explain the following term with their graphical representation: **[4]**

i) Hydraulic Grade Line.

ii) Total Energy Line.

b) Derive Dupit's equation. **[6]**

c) For the following velocity profiles, determine whether the flow is attached, detached or on the verge of separation. **[8]**

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

ii) $\frac{u}{U} = -2\left(\frac{y}{\delta}\right) + \left(\frac{y}{\delta}\right)^3 + 2\left(\frac{y}{\delta}\right)^4$

iii) $\frac{u}{U} = 2\left(\frac{y}{\delta}\right)^2 + \left(\frac{y}{\delta}\right)^3 - 2\left(\frac{y}{\delta}\right)^4$

OR

***Q6)*** a) Define the following term with brief explanations, **[4]**

i) Streamline body

ii) Bluff body

b) What do you mean by Boundary Layer Separation? Write the methods of preventing the separation of boundary layer? **[6]**

c) A pipe of diameter 0.4 m and of length 2000 m is connected to a reservoir at one end. The other end of the pipe is connected to a junction from which two pipes of lengths 1000 m and diameter 3000 m are parallel. These parallel pipes are connected to another reservoir, which is having level of water 10 m below the water level of the above reservoir. Determine the total discharge if f=0.015 Neglect minor losses. **[8]**

OR

***Q7)*** a) State and explain Buckingham's π- theorem? What do you mean by repeating variables? How are repeating variables selected in Dimensional Analysis? **[8]**

b) Prove that velocity through an orifice can be expressed as $V = \sqrt{2gH}\,\phi\left[\frac{\mu}{\rho VH}, \frac{D}{H}, \frac{\sigma}{\rho V^2 H}\right]$ H head, D orifice diameter, viscosity μ and density ρ, σ surface tension **[9]**

OR

***Q8)*** a) Define following Dimensionless number and state their significance: **[8]**

i) Reynolds Number

ii) Mach's Number

iii) Euler's Number

iv) Weber Number

b) The pressure difference $\Delta P$ in pipe of diameter D & length L due to viscous flow depends on velocity V and viscosity μ and density ρ. Using Buckingham's π theorem, obtain expression for pressure difference. as below $\Delta P = \frac{\mu v}{D} \times \frac{L}{D}\phi\left(\frac{SVD}{\mu}\right)$. **[9]**

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