Total No. of Questions : 8]

SEAT No. :

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[5925]-351

S.E. (Automobile & Mechanical Engg.)

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, Q7 or Q8.*
2) *Neat diagrams must be drawn wherever necessary.*
3) *Figures to the right indicate full marks.*
4) *Assume suitable data, if necessary.*
5) *Use of electronic pocket calculator is allowed.*

Q1) a) Define following terms : **[4]**

i) Path line ii) Stream line

iii) Streak line iv) Stream tube

b) Distinguish between : **[6]**

i) Uniform & Non uniform flow

ii) Steady & Unsteady flow

iii) Rotational & Irrotational flow

c) The velocity potential function is given by $\phi = (x^2 - y^2)$ find the velocity vector for the given fluid flow. Also show that ϕ represents possible case of flow. **[7]**

OR

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

i) Velocity potential

ii) Stream function

b) Derive continuity equation for 1D flow along streamline. **[6]**

c) The velocity vector in the fluid flow is given by $V = 2x^3\hat{i} - 5x^2y\hat{j} + 2t\hat{k}$. Obtain velocity & acceleration at point (2, 1, 0) at time t = 1s. **[7]**

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Q3) a) Differentiate between venturimeter & orificemeter. **[4]**

b) State & Derive Bernoulli's equation along streamline. **[6]**

c) An oil of specific gravity 0.9 & viscosity 10 poise is flowing through a pipe of diameter 110mm. The velocity at the center of pipe is 2m/s find : **[8]**

i) The pressure gradient in the direction of flow.

ii) Shear stress at the pipe wall

iii) Velocity at a distance 30mm from pipe wall

OR

Q4) a) Show that the value of coefficient of friction for viscous flow through the circular pipe is given by $f = 16/\text{Re}$. **[4]**

b) Derive an expression of velocity & shear stress distribution for laminar flow through pipe. **[6]**

c) A conical tube of length 3m is fixed vertically with its smaller end upwards. The velocity of flow at smaller end is 4m/s; while at its lower end is 2m/s. The pressure head at the smaller end is 2m of liquid. The loss of head through the pipe is $0.95\,(v_1 - v_2)^2/2g$ where v_1 velocity at smaller end & v_2 velocity at lower end. Determine the pressure head at the lower end. Flow takes place in downward direction. **[8]**

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

i) Hydraulic Grade line

ii) Total Energy line

b) What is siphon? Explain its working along with the diagram? **[6]**

c) Find the displacement thickness, the momentum thickness for the velocity distribution in the boundary layer is given by

$$\frac{u}{v} = 2\left(\frac{y}{\delta}\right).\left(\frac{y}{\delta}\right)^2.$$ **[8]**

OR

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

i) Boundary layer

ii) Boundary layer thickness

iii) Drag

iv) Lift

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 of 0.4m and 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 1000m and diameter 3000m are parallel. These parallel pipes are connected to another reservoir, which is having level of water 10m below the water level of the above reservoir. Determine the total discharge if $f = 0.015$. Neglect minor losses. **[8]**

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) The Frictional Torque of disc of diameter D rotating at a speed N in a fluid of viscosity μ and density ρ in a turbulent flow is given by

$$T = D^5 N^2 \rho \phi \left[\frac{\mu}{D^2 N \rho} \right].$$ **[9]**

OR

Q8) a) Explain the following Dimensionless number along with mathematical expressions : **[8]**

i) Reynolds Number

ii) Froude's Number

iii) Euler's Number

iv) Weber Number

b) A Fluid of density ρ and viscosity μ, flows at a velocity v through a circular pipe of diameter D. By using Buckingham's π-theorem. Prove that shear stress τ_0 at wall is given by $\tau_0 = \rho v^2 \phi \left[\frac{\rho v D}{\mu} \right]$. **[9]**

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