Total No. of Questions : 8]

SEAT No. :

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S.E. (Mechanical / Automobile)

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 side indicate full marks.***
4) ***Use of electronic pocket calculator is allowed.***
5) ***Assume Suitable data if necessary.***

Q1) a) Define path line, streak line and stream tube and give examples of each. **[4]**

b) Derive general equation for continuity for a 3D flow in Cartesian coordinates for a steady incompressible flow. **[6]**

c) Find acceleration and vorticity components at a point (1, 1, 1) for following flow field. Find Velocity potential. **[7]**

$$u = 2x^2 + 3y,\ v = 2xy + 3y^2 + 3zy\ \ w = \frac{-3z^2}{2} + 2xz - 9y^2z$$

OR

Q2) a) Differentiate between Convective and local Accelerations. **[4]**

b) Discuss various types of flow with suitable example and mathematical expression. **[4]**

c) The velocity component of 2D flow field are as follows. **[7]**

$$u = \frac{y^3}{3} + 2x - 2x^2y\ \ v = xy^2 - 2y - \frac{x^3}{3}$$

i) Whether flow is possible

ii) Obtain expression for stream function

iii) Obtain an expression for potential function

P.T.O.

Q3) a) Show that for a steady laminar flow through a circular pipe mean velocity of flow occurs at radial distance of 0.707 R from center of pipe where R is radius of pipe. **[4]**

b) Derive Bernoulli's equation from Euler's equation along a stream line. **[6]**

c) A lubricating oil of viscosity of 10 poise and specific gravity 0.8 is pumped through a 50 mm diameter pipe. If the pressure drop per meter length of pipe is 20 kN/m^2, determine : **[8]**

i) Discharge of oil in liter /sec

ii) Shear stress of pipe wall

iii) Total friction drag

Power required per 50m, length of pipe to maintain flow.

OR

Q4) a) Derive an expression of velocity and shear stress distribution for laminar flow through pipe. **[6]**

b) With neat sketch explain the HGL and TEL. **[4]**

c) Differentiate between venturimeter and Orificemeter.

Determine the flow rate of oil with specific gravity 0.7 flows through pipe of diameter 400 mm inclined at 30° with horizontal connected with mercury differetial manometer,Venturi meter of throat 200 mm gives deflection of 500 mm. Take throat to mouth distance of 600 mm and flow meter coefficient as 0.98. **[8]**

Q5) a) What is drag and Lift? Explain different types of drag on an immersed body. **[4]**

b) What is boundary layer? Explain with neat sketch the development of boundary layer over smooth flat plate. **[6]**

c) A pipeline of length 2km is used for power transmission. If 110.3625 kW power is to be transmitted through the pipe in which water having a pressure of 490.5 N/cm^2 at inlet is flowing. Find the diameter of the pipe and efficiency of transmission if the pressure drop over the length of pipe is 98.1 N/cm^2. Take f= 0.0065. **[8]**

OR

Q6) a) Explain with neat sketches, hydrodynamically smooth and rough boundaries. **[4]**

b) Explain the concept of equivalent pipe and derive Dupit's equation. **[6]**

c) Derive an expression for displacement, momentum and energy thicknesses. **[8]**

Q7) a) Explain Reynolds Number with example. **[4]**

b) In a geometrically similar model of weir the discharge is 0.15 m^3/s. If the scale of the model is 1/50, find the discharge of the prototype. **[4]**

c) Frictional torque T of a propeller in a turbulent flow depends on density of liquid ρ, viscosity of liquid μ, speed N rpm, diameter of propeller shaft D. Using Buckingham's pi theorem show that : **[9]**

$$T = \rho N^2 D^5 f\left[\frac{\rho N D^2}{\mu}\right]$$

OR

Q8) a) Explain the Weber's model law. **[4]**

b) Find the scale ratio of a model, by using the following data:

For model, velocity of water through the circular pipe is 1 m/s.

For prototype, velocity of oil 0.14 m/s through pipe of diameter 50mm. Assume V_{water} = 0.01 cm^2/ *sec*, v_{oil} = 0.007 cm^2/sec. For Dynamic similarity also find the diameter of pipe for model. **[4]**

c) Using Buckingham's pi theorem show that the discharge Q consumed by oil ring is given by:

$$Q = D^3 N f\left(\frac{\mu}{\rho N D^2}, \frac{\sigma}{\rho D^3 N^2}, \frac{\gamma}{\rho D N^2}\right)$$

Where, D = diameter of the ring, N = rotational speed of the shaft, ρ = density, μ = viscosity, σ = surface tension, γ = specific weight of the oil. **[9]**