

JK LAKSHMIPAT UNIVERSITY, JAIPUR

INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination (Regular), November, 2016

B. Tech in Chemical Engineering, III Semester

Roll No.....

CHE302: Fluid Flow Operation

Time: 3 hours

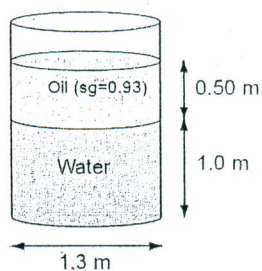
Max. Marks: 100

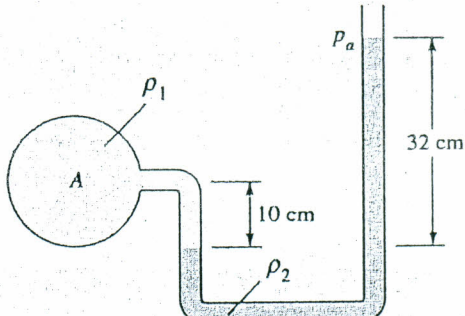
Instructions to students:

1. Do not write anything other than your roll number on question paper.
2. Assume suitable data wherever required and mention it clearly.
3. Writing appropriate units, nomenclature, and drawing neat sketches/schematics/ flow chart wherever, required are an integral part of the answer.

Q.1A	Objective type multiple choice questions (10 questions @ 1 mark)	10
i.	The property of the a fluid by virtue of which it offers resistance to shear is known as (a)Density, (b)Surface tension, (c) Viscosity, (d) Vapor pressure	
ii.	The flow is irrational if (a) $\nabla.V = 0$, (b) $\nabla \times V = 0$, (c) $\nabla \times V = 1$, (d) $\nabla.V = 1$	
iii.	Which of the following has the form of a Reynolds Number (Re): (a) $Re = \frac{DV\rho}{\mu}$, (b) $Re = \frac{DV\mu}{\rho}$, (c) $Re = \frac{DV^2\rho}{\mu}$, (d) $Re = \frac{V\rho}{D\mu}$	
iv.	The ration of the local velocity to the maximum velocity in laminar flow through pipes is given by (a) $\frac{u}{u_{\max}} = \frac{r}{R}$, (b) $\frac{u}{u_{\max}} = 1 - \left(\frac{r}{R}\right)^2$, (c) $\frac{u}{u_{\max}} = 1 - \left(\frac{r}{R}\right)$ (d) $\frac{u}{u_{\max}} = \left(\frac{r}{R}\right)^2$	
v.	A streamline and an equipotential line in a flow field (a) are parallel to each other; (b) are perpendicular to each other; (c) intersect at an acute angle; (d) are identical	
vi.	Manometer are important devices for measuring (a)absolute pressure, (b) Vacuum pressure, (c) local atmospheric pressure, (d) Pressure differences	
vii.	The center of buoyancy always (a) Coincide with the centre of gravity (b) Coincide with the centroid of the volume of the fluid displaced (c) Remain above the centre of gravity (d) Remain below the centre of gravity	

viii	The buoyant force on an object is dependent on
	(a) The object's density. (c) The submerged volume of the object.
	(b) The mass of the object. (d) The shape of the object
ix.	The apparent viscosity of a fluid is given by
	$0.006 \left(\frac{dV_x}{dy} \right)^{-0.3}$ Where $\left(\frac{dV_x}{dy} \right)$ is the velocity gradient. The fluid is
	(a) Bingham plastic; (b) Dilatants; (c) Pseudoplastic; (d) Thixotropic
x.	An incompressible fluid flows radially outward from a line source in a steady manner. How does the velocity in any radial direction vary?
	(a) r; (b) 1/r; (c) r ² ; (d) 1/r ²

Q.2	Short answer type questions (2 questions @ 5 marks)	10
i.	Determine the force exerted by the oil and water upon the bottom plane area of the barrel.	
ii.	The pressure outside the droplet of water of diameter 0.05 mm is 1.0133 bar (atmospheric pressure). Calculate the pressure within the droplet if surface tension is given as 0.07 N/m of water.	

Q.3A	In Fig. fluid 1 is oil (SG = 0.87) and fluid 2 is glycerin at 20°C (SG = 1.26). If $P_a = 98 \text{ kPa}$, Determine the absolute pressure at point A.	10
		

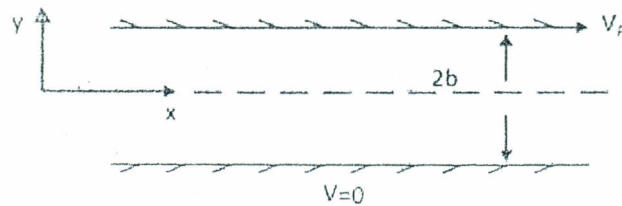
Q.4A	The velocity field in fluid medium given by	10
	$\vec{V} = 3xy^2\mathbf{i} + 2xy\mathbf{j} + (2zy + 3t)\mathbf{k}$	
	Find the magnitude and direction of (i) Translation velocity, (ii) rotational velocity and (iii) the vorticity of the fluid elements at (1,2,1) and at time t = 3.	

Q.5A	The stream function in a xy-plane is given below: $\psi = x^3y^2z^1$, Find the velocity vector for this stream function.	10
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Q.6A Derive the Navier Stokes equation and physical significant of each and every terms in this equation. 10

OR

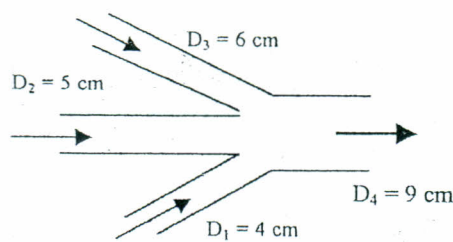
Q.6A Consider the steady-state 2D-flow of an incompressible Newtonian fluid in a long horizontal rectangular channel. The bottom surface is stationary, whereas the top surface is moved horizontally at the constant velocity, V_p . Determine the velocity field in the channel. Assume fully developed flow. 10



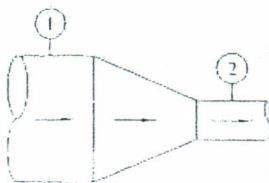
Q.7A Derive the Continuity equation: $\frac{\partial \rho}{\partial t} + \nabla \cdot (\rho \mathbf{V}) = 0$ 10
If the fluid is incompressible then $\nabla \cdot \mathbf{V} = 0$.

OR

Q.7A Three pipes steadily deliver water at 20°C to a large exit pipe in Fig. 2. The Velocity $V_2 = 5$ m/s, and the exit flow rate $Q_4 = 120$ m³/h. Find (a) V_1 ; (b) V_3 ; and (c) V_4 if it is known that increasing Q_3 by 20% would increase Q_4 by 10%. 10



Q.8A Water at 20°C flow steadily at 40 kg/s through the nozzle in figure. If $D_1 = 18$ cm and $D_2 = 5$ cm. Compute the average velocity in m/s at (a) Section 1 and section 2 10



Q.9A The pipe flow in the figure fills a cylindrical tank as shown. At time $t = 0$, the water depth in the tank is 30 cm. estimate the time required to fill the remainder of the tank. 20

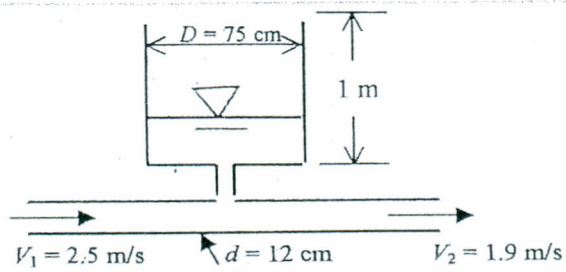


Fig. P3.12

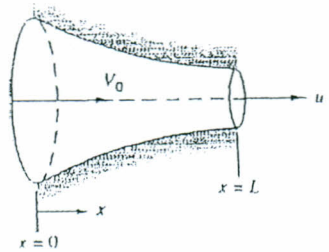
OR

Q.9A Assume that flow in the converging nozzle of Fig. 1 has the form

20

$$\bar{V} = V_0 \left(1 + \frac{2x}{L} \right) i$$

Compute (a) the fluid acceleration at $x = L$; and (b) the time required for a fluid particle to travel from $x = 0$ to $x = L$.



Best of Luck