(b) Water is flowing in a 15 cm diameter smooth glass pipe at an average velocity of 15 m/s. Find the thickness of (i) the laminar sub-layer, and (ii) the transition layer. The kinematic viscosity of water at the prevailing temperature is 0.009 cm^2/sec.

(c) Liquid flows through an orifice in the bottom of a cylindrical tank at a velocity of 4m/s. If the jet diameter is 2.5 cm, what is the rate of flow in lit/sec ? If the tank is 25 cm in diameter, at what rate is the liquid surface falling ?

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PAPER ID : 4070

TCE-301 Printed Pages : 4

Paper ID and Roll No. to be filled in your Answer Book

Roll No.

B. Tech.

(SEM. III) (ODD SEM.) (REG. & BACK) EXAMINATION, 2012-13

FLUID MECHANICS

Time : **3** Hours] [Total Marks : **100**

Note : Answer all the questions.

1 Attempt any four of the following : **4×5=20**

(a) Distinguish between solids, liquids and gases.

(b) Discuss Newton's law of viscosity. What is the effect of temperature change on viscosity of fluid ?

(c) Explain what you mean by capillarity. Derive an expression for capillarity fall.

(d) Explain the term absolute, gauge, atmospheric and vaccum pressure with the help of neat sketch.

(e) Distinguish between streamline, streak lines and path lines.

(f) What do you understand by vorticity ?

2 Attempt any four of the following : **4×5=20**

(a) What are the limitations of Bernoulli's equation ?

(b) In what way are the Navier-Stokes equations of motion different from those of Euler's equations ?

(c) Which form of Bernoulli's equation will be more suitable for application to flow of gases ?

(d) The velocity potential function is given by $\varnothing = 5\left(x^2 - y^2\right)$. Calculate the velocity and its direction at the point (6,8)

(e) A rectangular tank 1.5 meter wide, 2.0 meter high and 3.0 meter long contains water to a depth of 1.0 meter and a lighter liquid (sp. Gr. 0.85) on the water to a depth of .70 meter. Find the magnitude and location of the force on one end of the tank.

(f) The flow of a fluid has velocity components

$u = 3x+y$

$v = 2x - 3y$

Determine whether the flow is irrotational or not.

3 Attempt any two parts of the following : **10×2=20**

(a) What are dimensionless numbers ? Derive the mathematical expressions for following dimensionless numbers and also mention their significance.

(i) Reynolds number

(ii) Mach number

(b) The pressure loss (Δp) due to a valve fixed in a pipe depends on the pipe diameter D, average velocity in the pipe V, mass density ρ, and viscosity μ and the characteristic length of orifice d. Determine general form of dimensionally homogeneous equation.

(c) Define co-efficient of velocity, co-efficient of discharge, co-efficient of contraction. An oil of sp. gr. 0.8 is flowing through a venturimeter having inlet diameter 30 cm and throat diameter 15 cm the oil-mercury differentil manometer shows a reading of 25 cm. Calculate the discharge of oil through the horizontal venturimeter. Take $C_d = 0.98$.

4 Attempt any two parts of the following : **10×2=20**

(a) Explain why resistance to flow through pipe is independent of the surface roughness at low Reynolds numbers whereas it depends only on the relative roughness at high Reynolds number.

(b) The power P required to drive a fan or blower depends upon the fluid density ρ, fluid viscosity μ, impeller diameter D, flow rate Q and rotational speed N. Express these variables in dimensionless form. Show that $\rho ND^2/\mu$ is a form of Reynolds number.

(c) A circular cylinder is rotated about its own axis at a constant rate of 1500 rpm. Determine the centripetal acceleration at a radial distance of 15 cm. and Find the ratio of this acceleration to the acceleration due to gravity.

5 Attempt any two parts of the following : **10×2=20**

(a) Show the discharge per unit width between two parallel plates distance 'b' apart, when one plate is moving at velocity 'U' while the other one is held stationary, for the condition of zero shear at the fixed plate is $q = bU/3$