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06 JAN 2023

Please check that this question paper contains 9 questions and 3 printed pages within first ten minutes.

[Total No. of Questions: 09] [Total No. of Pages: 03]

Uni. Roll No. .....

Program: B.Tech. (Batch 2018 onward)
Semester: 3rd
Name of Subject: Fluid Mechanics
Subject Code: PCCE-103
Paper ID: 16022
A scientific calculator is Allowed

Time Allowed: 03 Hours **Max. Marks: 60**

NOTE:

1) Parts A and B are compulsory.
2) Part C has Two Questions Q8 and Q9. Both are compulsory, but with internal choice.
3) Any missing data may be assumed appropriately.

Part – A **[Marks: 02 each]**

Q1.

a) State and explain Newton's law of viscosity.

b) Discuss the term viscous flow.

c) Define the terms: Metacentre and metacentric height

d) Differentiate between steady and unsteady flow with examples.

e) A liquid has viscosity of 5.5×10^{-2} Ns/m^2. Express the viscosity in Poise. Also find the kinematic viscosity of the fluid, if the specific gravity of the fluid is 0.8.

f) What is a pitot tube? How is it used to measure the velocity of flow3 at any point in a pipe?

Part – B **[Marks: 04 each]**

Q2. Discuss the procedure for the selection of repeating variables in Buckingham's π-theorem.

Q3. Discuss various types of head losses in pipes. Also, give their expressions.

Q4. Sketch specific energy curves and list its important features.

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Q5. In a 3-dimensional incompressible fluid flow, the velocity components are;

$u = x^2 + z^2 + 5$, $v = y^2 + z^2 - 3$

(i) Determine third component of velocity

(ii) Is fluid flow being rotational?

Q6. A pipe 200 m long slopes down at 1 in 100 and tapers from 600 mm diameter at the higher end to 300 mm diameter at the lower end and carries 100 litres/sec of oil (specific gravity 0.8). If the pressure gauge at the higher end is 60 kN/m^2. Neglect all the losses.

Determine: (i) Velocities at two ends of pipe. (ii) Pressure at lower end.

Q7. An isosceles triangular plate of base 5 m and altitude 5 m is immersed vertically in an oil of specific gravity 0.8. The base of the plate is 1 m below the free surface. Determine:

(i) The total pressure

(ii) The centre of pressure

Part – C **[Marks: 12 each]**

Q8. a) U-tube manometer containing mercury was used to find the negative pressure in pipe containing water. The right limb was open to the atmosphere. Find the vacuum pressure in the pipe, if the difference of mercury level in the two limbs was 100 mm and the height of water in the left limb from the centre of the pipe was found to be 40 mm below.

b) What do you understand by Prandtl's mixing length theory? Also, write an expression for shear stress due to Prandtl.

OR

A hydraulically efficient trapezoidal channel with side slope of 1:1 has to be designed to convey 14 m^3/s with a gradient of 1 in 1000. If unlined, the value of Chezy's C is 45. If lined with concrete, the value of C is 70. If cost per m^3 of excavation is three times the cost per m^2 of lining, will the lined or unlined channel be cheaper.

Q9. Determine rate of flow of water through a pipe 300 mm diameter placed in an inclined position where a venturimeter is inserted, having throat diameter of 150 mm. The difference of pressure between the main and throat is measured by a

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liquid of specific gravity 0.7 in an inverted U-tube which gives a reading of 260 mm. The loss of head between the main and throat is 0.3 times the kinetic head of pipe.

OR

A horizontal pipe line 50 m long is connected to a water tank at one end and discharges freely into the atmosphere at the other end. For first 30 m of its length from the tank, the pipe is 200 mm in diameter and its diameter suddenly enlarged to 400 mm. The height of the water level in the tank is 10 m above the centre of the pipe. Considering all minor losses, determine rate of flow. Take f = 0.01 for both sections of the pipe. Also draw Hydraulic Gradient Line and Total Energy Line.

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