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B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

May 2023 Semester End Main Examinations

Programme: B.E. **Semester: III**
Branch: CIVIL ENGINEERING **Duration: 3 hrs.**
Course Code: 19CV3PCMOF **Max Marks: 100**
Course: Mechanics of Fluids **Date: 15.05.2023**

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

UNIT - I

1 a) Define (i) Mass Density (ii) Specific Weight (iii) Specific Gravity (iv) Pressure Head (v) Capillarity **05**

b) Derive an expression for variation of pressure in a fluid in static condition. **07**

c) The space between two square flat plates is filled with oil. Each side of plate is 60 cm. The thickness of oil film is 12.5 mm. The upper plate which moves at 2.5 m/s requires a force of 98.1 N to maintain the speed. Determine (i) Dynamic Viscosity and (ii) Kinematic viscosity of the oil if Specific gravity is 0.95. **08**

OR

2 a) With a neat sketch derive the expression for the pressure difference between two points at the same vertical level, using a differential U-tube manometer. **05**

b) As shown in the Figure 1, pipe ***M*** contains carbon tetrachloride of specific gravity 1.594 under a pressure of 1.05 kg(f)/cm^2 and pipe ***N*** contains oil of specific gravity 0.8. If the pressure in the pipe *N* is 1.75 kg(f)/cm^2 and the manometric fluid is mercury, find the difference ***x*** between the levels of mercury. **07**

c) A body of mass 100 kg slides down at a uniform speed of 1 m/s along lubricated inclined plane making 30^o with the horizontal. The viscosity of the lubricant is 0.1 N.s/m^2 and contact area is 0.25 m^2. Determine the thickness of the lubricant assuming a linear velocity distribution. **08**

UNIT – II

3 a) A square aperture in a vertical side of a tank has one diagonal vertical and is completely covered by a plane plate hinged along upper side of the aperture. The diameter of aperture is 2 m long and tank contains a liquid of relative density 1.5. The center of aperture is 1.5 m below the free surface. Calculate the magnitude and the position of the thrust exerted on the plate by liquid. **10**

b) A rectangular gate 5 x 2 m is hinged at its base and inclined at 60^o to the horizontal as shown in Figure 2. To keep the gate in stable position a counter weight of 50 kN is attached at the upper end of the gate. Find the depth of water at which the gate begins to fall. Neglect the weight of gate and friction at the pulley and hinge. **10**

UNIT - III

4 a) Explain the terms: velocity potential, stream line and equipotential line. **06**

b) Derive the expression for continuity equation in Cartesian coordinates. **07**

c) The velocity potential for a flow is given by the function $\phi=-xy^3/3-x^2+x^3y/3+y^2$. Determine (i) The velocity components in x and y directions (ii) Show that ϕ represents a possible case of flow. **07**

OR

5 a) Justify preferred use of Eulerian approach than Lagrangian approach in fluid mechanics with an example. **05**

b) Explain with usual notations the local and convective acceleration **05**

c) Verify whether the following are valid potential functions (i) $\phi = 2x + 5y$, (ii) $\phi = 4x^2 - 5y^2$. Also prove that the flow is irrotational if the potential functions are valid. **10**

UNIT - IV

6 a) A pipeline carrying oil of specific gravity 0.87, changes in diameter from 200 mm at a point A to 500 mm at a point B which is 4 m above point A. If the pressures at A and B are 9.81 N/cm^2 and 5.886 N/cm^2 respectively and the discharge is 200 litres/s, determine the loss of head and the direction of flow. **06**

b) Explain the working principle of a Pitot tube. Derive the equation for the velocity using a Pitot tube. **06**

c) A venturimeter has its axis vertical, the inlet and the throat diameters being 150mm and 75 mm respectively. The throat is 225 mm above inlet. Petrol of specific gravity 0.78 flows up through the meter at a rate of 0.029 m^3/s. Calculate the pressure difference between the inlet and the throat. Assume the coefficient of discharge of the meter as 0.96. **08**

UNIT - V

7 a) Derive the equation of head loss in the pipe due to friction using Darcy's equation. **05**

b) The top and bottom diameters of a 2m long vertical tapering pipe are 10 cm and 5 cm respectively. Water flows down the pipe at 30 lit/sec. Find the pressure difference between the two ends of the pipe. **08**

c) Water flows over a triangular right angled weir first and then over a rectangular weir of crest width 1m. The discharge coefficient of the triangular and rectangular weirs are 0.6 and 0.7 respectively. If the depth of the water over the triangular weir is 360 mm, find the depth of water over rectangular weir. **07**

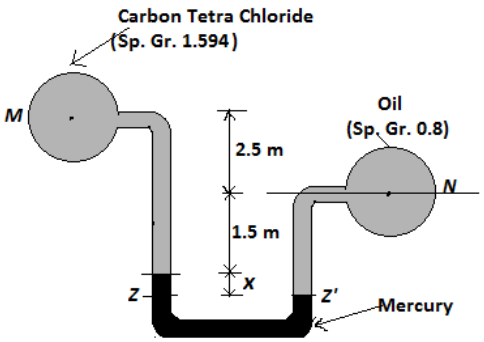

Figure 1

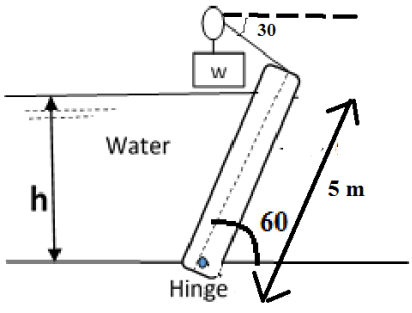

Figure 2

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