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

Autonomous Institute Affiliated to VTU

September / October 2023 Supplementary Examinations

Programme: B.E. **Semester: III**
Branch: CIVIL ENGINEERING **Duration: 3 hrs.**
Course Code: 19CV3PCMOF **Max Marks: 100**
Course: Mechanics of Fluids **Date: 16.09.2023**

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

UNIT - I

1	a)	Define the following terms : (i) Mass density (ii) Surface tension (iii) Specific volume (iv) Bulk modulus (v) Fluid continuum	**05**
	b)	Derive the expression for capillary rise *h* when a narrow tube of diameter *d* is held partially immersed in a liquid having surface tension σ and specific weight γ.	**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)	Explain the following with a neat sketch: i) Absolute pressure ii) Gauge pressure and iii) Vacuum pressure.	**05**
	b)	State Pascal's law and prove that the pressure is the same in all directions at a point in a static fluid.	**07**
	c)	The pressure between two points A and B in a pipe conveying oil of specific gravity 0.8 is measured by an inverted U-tube. The column connected to point B stands 1.6 m higher than that at point A. A commercial pressure gauge attached directly to the pipe at A reads 1.125×10^4 kg(f)/m^2. Determine the manometer reading when attached directly to the pipe at B.	**08**

UNIT – II

3	a)	Derive the expression for total pressure and center of pressure on a vertical plane fully submerged in a liquid.	**06**
	b)	A circular plate 3.0 m diameter is immersed in water in such a way that its greatest and least depth below the free surface are 4 m and 1.5 m respectively. Determine the total pressure on one face of the plate and position of the centre of pressure.	**06**
	c)	Determine the magnitude and direction of the resultant force due to water acting on a roller gate of cylindrical form of 4.0 m diameter, when the gate is placed on the dam in such a way that water is just going to spill. Take the length of the gate as 8 m.	**08**

UNIT - III

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

b) Two velocity components are $u = x^3 + y^2 + 2z^2$ and $v = -x^2y - yz - xy$. Determine the third component such that they satisfy the continuity equation. **07**

c) For a 2-dimensional flow field stream function is given as $\psi = 1.5(y^2 - x^2)$. Determine the velocity components at the points (1,3) and (3,3). Also, find the discharge passing between the streamlines passing through the points given above. **08**

OR

5 a) Explain velocity potential and stream functions and show the relation between them. **05**

b) A velocity field is given by $u = 2yz$, $v = 2xz$ and $w = 2xy$. At $(x, y, z) = (2,2,1)$. Calculate (i) the velocity (ii) local acceleration and (iii) convective acceleration. **07**

c) The velocity components of a two dimensional flow for an incompressible fluid are expressed as $u = \frac{y^3}{3} + 2x - x^2y$; $v = -\frac{x^3}{3} - 2y + y^2x$ **08**

Show that it represents possible case of irrotational flow. Determine the velocity potential of the flow field.

UNIT - IV

6 a) State Bernoulli's principle. From Newton's second law of motion, derive the Bernoulli's equation. **10**

b) A venturimeter, having a diameter of 75 mm at the throat and 150 mm diameter at the enlarged end, is installed in a horizontal pipeline 150 mm in diameter carrying an oil of specific gravity 0.9. The difference of pressure head between the enlarged end and the throat recorded by a U-tube manometer is 175 mm of mercury. Determine the discharge through the pipe. Assume the coefficient of discharge of the meter as 0.97. **10**

UNIT - V

7 a) Explain the advantages of using triangular notch over rectangular notch. **05**

b) The population of a city is 8,00,000 and it is to be supplied with water from a reservoir 6.4 km away. Water is to be supplied at the rate of 140 litres per head per day and half the supply is to be delivered in 8 hours. The full supply level of the reservoir is R.L 180.00 and its lowest water level is R.L. 105.00. The delivery end of the main is at R.L. 22.50 and the head required there is 12 m. Calculate the diameter of the pipe required. Take friction factor f = 0.04. **07**

c) Determine the maximum velocity of approach that can be neglected if the discharge is to be measured within 3% accuracy by using triangular notch to measure flow in a channel under a head of 1.5 m. **08**

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