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

**Autonomous Institute Affiliated to VTU**

## January / February 2025 Semester End Main Examinations

**Programme: B.E.** **Semester: III**

**Branch: Civil Engineering** **Duration: 3 hrs.**

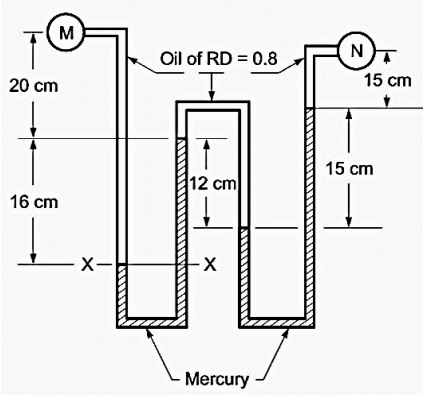
**Course Code: 23CV3PCFME / 22CV3PCFME** **Max Marks: 100**

**Course: Fluid Mechanics**

**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 | CO | PO | Marks |
|---|---|---|---|---|---|---|
| 1 | a) | | Differentiate between kinematic and dynamic viscosity. | CO1 | PO1 | 04 |
| | b) | | Given that 3 litres of petrol weights 23.7 N. Determine its mass density, specific weight, specific volume and specific gravity. | CO1 | PO1 | 08 |
| | c) | | In a hydraulic lift designed for automobile fitting, the ram has a diameter of 25 cm and moves within a cylinder with an internal diameter of 25.018 cm. The space between the ram and the cylinder is filled with oil of kinematic viscosity of 3.7 cm²/s and a relative density 0.85. If the ram moves at a speed of 15 cm/s and 3.3 m of the ram is within the cylinder, calculate the frictional resistance. | CO1 | PO1 | 08 |
| | | | **OR** | | | |
| 2 | a) | | State and explain the hydrostatic law. | CO1 | PO1 | 04 |
| | b) | | Determine the smallest diameter of a glass tube required to measure the water level, if the capillary rise in the tube is limited to 2 mm. Assume the surface tension of water in contact with air is 0.0736 N/m. | CO1 | PO1 | 08 |
| | c) | | Calculate the pressure difference ($p_M$ - $p_N$) based on the readings shown in the manometer in Fig. 1.   Fig.1 | CO1 | PO1 | 08 |

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| | | | **UNIT - II** | | | |
| | 3 | a) | Define the terms total pressure and centre of pressure.<br>For a right-angled triangular plane with height *h* immersed vertically in water, with its vertex at the water surface, calculate both the total force exerted on one side of the triangle and the position of the center of pressure. | ***CO1*** | ***PO1*** | **10** |
| | | b) | A circular plate of diameter 0.75 m is immersed in a liquid of relative density 0.80, and is inclined at 30° to the horizontal. Center of the plate is located at 1.50 m below the free liquid surface. Calculate the total force exerted on one side of the plate and the location of the center of pressure. | ***CO1*** | ***PO1*** | **10** |
| | | | **OR** | | | |
| | 4 | a) | For a flat inclined lamina fully submerged in a liquid, show that the total pressure acts always below the centroid of the lamina. | ***CO1*** | ***PO1*** | **10** |
| | | b) | A circular gate in a vertical wall has a diameter of 4 m. The water surface on the upstream side is 8 m above the top of the gate, and on the downstream side is 1 m above the top edge of the gate. Determine the forces acting on the two sides of the gate, the resultant force acting on the gate and the position of the resultant. | ***CO1*** | ***PO1*** | **10** |
| | | | **UNIT - III** | | | |
| | 5 | a) | Define the following terms related to fluid flow: path line, streak line, stream tube, and equipotential line. | ***CO2*** | ***PO1*** | **04** |
| | | b) | Explain local, convective and total acceleration, using standard notations. | ***CO2*** | ***PO1*** | **06** |
| | | c) | The velocity potential for a flow is given by<br>$\phi = -xy^3/3 - x^2 + x^3y/3 + y^2$.<br>(i) Derive the velocity components in the *x* and *y* directions.<br>(ii) Show that $\phi$ represents a possible case of flow. | ***CO2*** | ***PO1*** | **10** |
| | | | **OR** | | | |
| | 6 | a) | Differentiate between steady and uniform flow. Give an example for both. | ***CO2*** | ***PO1*** | **04** |
| | | b) | Define stream function and velocity potential function, and explain the relationship between the them. | ***CO2*** | ***PO1*** | **06** |
| | | c) | If for two-dimensional potential flow, $\phi = (2xy-x)$ represents the velocity potential. Determine the magnitudes of velocity and the stream function $\psi$ at a point *P* (4,5). | ***CO2*** | ***PO1*** | **10** |
| | | | **UNIT - IV** | | | |
| | 7 | a) | Pitot tubes are commonly used to determine the speed of aircraft. With a neat sketch explain the working principle of a pitot tube. | ***CO2*** | ***PO1*** | **06** |

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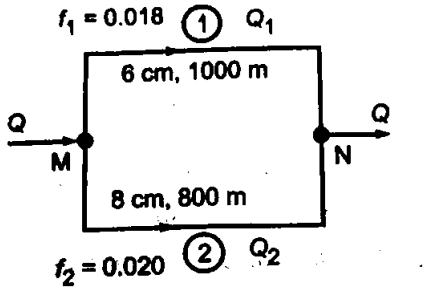
| | | b) | A discharge of 100 litres/sec is to be measured by a triangular notch of vertex angle 60°. The coefficient of discharge of the notch is 0.58. Calculate the head over the notch for the given discharge. | *CO2* | *PO1* | **06** |
| | | c) | A pipeline with a diameter of 15 cm at section *A* is positioned at an elevation of 100.00 m. At section *B*, the pipeline has a diameter of 30 cm and is located at an elevation of 107.00 meters. When water flows at the rate 50 liters/sec. through the pipe, the pressure at section *A* is measured to be 30 kPa, and the energy loss in the pipe is 2 m.<br>Calculate the pressure at section *B* when (i) the flow is from *A* to *B* and (ii) the flow is from *B* to *A*. | *CO2* | *PO2* | **08** |
| | | | **OR** | | | |
| | 8 | a) | Elaborate on the experimental procedure to determine the hydraulic coefficients of an orifice. | *CO2* | *PO1* | **06** |
| | | b) | A closed tank, partially filled with water, discharges through an orifice of 12.5 mm diameter and has a coefficient of discharge of 0.65. If air is pumped into the upper part of the tank, determine the pressure required to produce a discharge of 36.6 litres/minute when the water surface is 1 m above the outlet. | *CO2* | *PO1* | **06** |
| | | c) | A rectangular weir 0.75 m high and 1.5 m long is to be used for discharging water from a tank under a head of 0.5 m. Assume coefficient of discharge as 0.661, and neglect the velocity of approach.<br>Estimate the discharge when used as (i) a suppressed weir and (ii) as a contracted weir. | *CO2* | *PO2* | **08** |
| | | | **UNIT - V** | | | |
| | 9 | a) | A pipe 6 cm in diameter, 1000 m long and with Darcy's friction factor $f = 0.018$ is connected in parallel between two points *M* and *N* with another pipe 8 cm diameter, 800 m long and having $f = 0.020$. A total discharge of 20 litres/ sec enters the parallel pipes trough division at *M* to rejoin at *N* as shown in Fig. 2. Estimate the division of discharge in the two pipes.<br>  <br><br>Fig. 2 | *CO3* | *PO1* | **10** |
| | | b) | Consider a compound piping system consisting of 1800 m of 50 cm diameter pipe, 1200 m of 40 cm diameter pipe, and 600 m of 30 cm diameter pipe, all of the same material and connected in series. | *CO3* | *PO2* | **10** |

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| | | | (i) Determine the equivalent length of a 40 cm diameter pipe that would have the same frictional loss as the combined system.<br>(ii) Calculate the equivalent diameter of a single pipe if the total length of the pipe system is 3600 m. | | | |
| | | | **OR** | | | |
| | 10 | a) | A pipeline 0.225 m in diameter and 1580 m long has a slope of 1 in 200 for the first 790 m and 1in 100 for the next 790 m. The pressure at the upper end of the pipeline is 107.91 kPa, and at the lower end is 53.955 kPa. Taking friction factor = 0.032, determine the discharge through the pipe. | ***CO3*** | ***PO1*** | **10** |
| | | b) | Three pipes of 400 mm, 200 mm, and 300 mm diameters have lengths of 400 m, 200 m, and 300 m respectively. They are connected in series to make a compound pipe. The ends of this compound pipe are connected with two tanks whose difference of water levels is 16 m.<br>Assuming co-efficient of friction as 0.005 for all these pipes, determine the discharge through the compound pipe (i) neglecting the minor the minor losses and (ii) considering all the possible minor losses. | ***CO3*** | ***PO2*** | **10** |

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