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

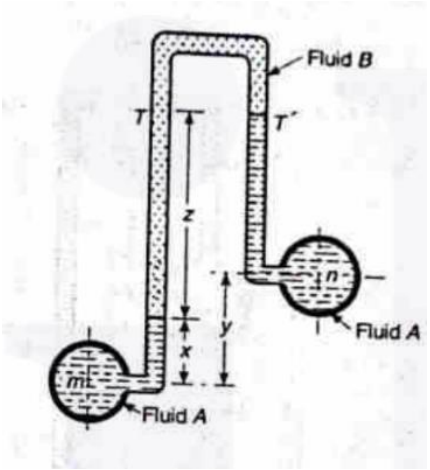
**Autonomous Institute Affiliated to VTU**

## April 2024 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**

**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) | Calculate the depth of a point below water surface in sea, where pressure intensity in 1.006 MN/m$^2$. The relative density of sea water is 1.025. | *CO* 1 | *PO1* | **6** |
| | b) | Determine the minimum size of glass tube that can be used to measure water level, if the capillary rise in the tube is not to exceed 0.25 cm. Take surface tension of water in contact with air as 0.0075 kg(f)/m. | *CO* 1 | *PO1* | **6** |
| | c) | Prove that in a static fluid mass, the pressure does not change along the x or y directions. Also, derive the expression for the pressure variation along the z-direction. | *CO* 1 | *PO1* | **8** |
| | | **OR** | | | |
| 2 | a) | Carbon-tetra chloride has a mass density of 1594 kg/m$^3$, calculate its mass density, specific weight and specific gravity. | *CO* 1 | *PO1* | **6** |
| | b) | A plate 0.0254 mm distant from a fixed plate, moves at 61 cm/sec and requires a force of 0.2 kg(f)/m$^2$ to maintain this speed. Determine the dynamic viscosity of the fluid between the plates. | *CO* 1 | *PO1* | **6** |
| | c) | A differential manometer is connected at the two points *m* and *n* as shown in Fig. 1. The fluids A and B are water and oil (relative density = 0.85) respectively. For $Z$ = 0.7 m and $y$ = 1.5 m, compute the pressure difference between *m* and *n*.   Fig. 1. | *CO* 1 | *PO1* | **8** |

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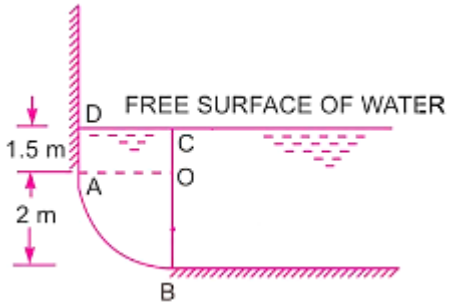
| | | | **UNIT - II** | | | |
| | 3 | a) | For a vertical lamina fully submerged in a liquid, prove that the total pressure always acts below the centroid. | ***CO*** 2 | ***PO1*** | **6** |
| | | b) | Determine the total pressure and centre of pressure on an isosceles triangular plate of base 4 m and altitude 4 m when it is immersed vertically in an oil of relative density 0.9. The base of the plate coincides with the free surface of oil. | ***CO*** 2 | ***PO1*** | **6** |
| | | c) | Compute the horizontal and vertical components of the total force acting on a curved surface *AB*, which is in the form of a quadrant of a circle of radius 2 m as shown in Fig. 2. Take the width of the gate as unity.<br>  <br><br>Fig. 2. | ***CO*** 2 | ***PO2*** | **8** |
| | | | **UNIT - III** | | | |
| | 4 | a) | Differentiate between streamline, streak line and path line in a fluid flow. | ***CO*** 3 | ***PO1*** | **6** |
| | | b) | Two velocity components of a flow field are given as<br>$u = x^3 + y^2 + 2z^2$ and $v = -x^2y - yz - xy$.<br>Determine the third component such that they satisfy the continuity equation. | ***CO*** 3 | ***PO1*** | **6** |
| | | c) | Derive the continuity equation in Cartesian coordinates, for a three dimensional steady incompressible flow of fluid. | ***CO*** 3 | ***PO1*** | **8** |
| | | | **OR** | | | |
| | 5 | a) | Differentiate between (i) steady flow and uniform flow (ii) laminar and turbulent flow (iii) local and convective acceleration. | ***CO*** 3 | ***PO1*** | **6** |
| | | b) | For a three-dimensional flow field given below, determine the components of acceleration, and the magnitude of total acceleration at a point (x, y, z) = (1, 2, 3).<br>$\boldsymbol{V} = (y^2+z^2)\boldsymbol{i} + (x^2+z^2)\boldsymbol{j} + (x^2+y^2)\boldsymbol{k}$ | ***CO*** 3 | ***PO1*** | **6** |
| | | c) | Velocity components in a two-dimensional flow field for an incompressible fluid are expressed as<br>$u = (y^3/3) + 2x - x^2y$ and $v = xy^2 - 2y - (x^3/3)$.<br>Derive the expression for the velocity potential function. | ***CO*** 3 | ***PO1*** | **8** |
| | | | **UNIT - IV** | ***CO*** 3 | ***PO1*** | **8** |
| | 6 | a) | In a pitot static tube the stagnation pressure is 3.0 kPa and the static pressure is -3.0 kPa (gauge). The liquid is air (relative density = 1.2 kg/m$^3$). Calculate the velocity of flow by taking the instrument coefficient as 0.98. | ***CO*** 4 | ***PO1*** | **6** |

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| | | b) | A 0.25 m diameter pipe carries oil of specific gravity 0.8 at the rate of 120 litres per second and the pressure at a point A is 19.62 $kN/m^2$ (gauge). If the point A is 3.5 m above the datum line, calculate the total energy at point A in metres of oil. | ***CO*** 4 | ***PO1*** | **6** |
| | | c) | A venturimeter having a diameter of 75 mm at the throat and 150 mm 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. | ***CO*** 4 | ***PO1*** | **8** |
| | | | **UNIT - V** | | | |
| | 7 | a) | With a neat sketch explain the term vena-contracta for a free jet from an orifice, and discuss its importance in fluid mechanics. | ***CO*** 4 | ***PO1*** | **6** |
| | | b) | A right-angled V-notch is used for measuring a discharge of 30 litres/sec. An error of 1.5 mm was made while measuring the head over the notch. Calculate the percentage error in the discharge. Take coefficient of discharge as 0.62. | ***CO*** 4 | ***PO1*** | **6** |
| | | c) | A compound piping system consists of 1800 m of 50 cm, 1200 m of 40 cm and 600 m of 30 cm diameter pipes of the same material connected in series.<br>i) Determine the equivalent length of a 40 cm pipe of the same material.<br>ii) Calculate the equivalent size of a pipe of 3600 m long. | ***CO*** 4 | ***PO1*** | **8** |

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