

BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(MID SEMESTER EXAMINATION)

CLASS: BTECH
BRANCH: CHEM & FT

SEMESTER : III
SESSION : MO/2025

SUBJECT: CL24203 FLUID MECHANICS

TIME: 02 Hours

FULL MARKS: 25

INSTRUCTIONS:

1. The question paper contains 5 questions each of 5 marks and total 25 marks.
 2. Attempt all questions.
 3. The missing data, if any, may be assumed suitably.
 4. Tables/Data handbook/Graph paper etc., if applicable, will be supplied to the candidates
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|--------|---|-------|----|
| Q.1 | A U-tube manometer is used to measure the pressure of water in a pipe line, which is in excess of atmospheric pressure. The right limb of the manometer contains mercury and is open to water in the main line, if the difference in level of mercury is in the left limb. Determine the pressure of water in the main line, if the difference in level of mercury in the limbs of U-tube is 10 cm and the free surface of mercury is in level with the centre of the pipe. | [5] 1 | 3 |
| Q.2 | A pipe line which is 4m in diameter contains a gate valve. The pressure at the centre of the pipe is 19.6 N/cm ² . If the pipe is filled with oil of Specific Gravity of 0.87; find the force exerted by the oil upon the gate and position of centre of pressure. | [5] 1 | 3 |
| Q.3(a) | Derive the expression of the rate of angular deformation over a fluid element and establish its correlation with applied shear stress. | [2] 2 | 2 |
| Q.3(b) | Viscosity of an oil kept between a shaft and sleeve is 6 poise. The shaft is having diameter of 0.2 m, length 1.5 m, and rotates at 100 rpm. The clearance between the shaft and the sleeve is 2 mm. Determine the power lost in the bearing. | [3] 2 | 5 |
| Q.4(a) | For a 2D, incompressible, steady flow the y-component velocity is given as $v = ky^2$. Determine the expression of possible x-component velocity. | [2] 2 | 3 |
| Q.4(b) | The expression of a fluid velocity field is given as, $V = a(x\hat{i} - y\hat{j})$, where V is in m/s, and $a = 0.2$. Find the equation of streamline and plot it. Determine the location of a fluid particle with initial position (2,4) in the velocity field after 5 s. | [3] 2 | 5 |
| Q.5(a) | Write the definitions of pathline and streamline. | [2] 2 | 1 |
| Q.5(b) | Water (Kinematic viscosity, $\nu = 1 \times 10^{-6} \text{ m}^2/\text{s}$) flows at a velocity of 0.1 m/s in a pipe of diameter, $D = 0.05 \text{ m}$. Calculate Reynolds Number (Re) and entrance length (L_e). | [3] 3 | 2 |

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