

**BALLARI INSTITUTE OF TECHNOLOGY & MANAGEMENT**

(Autonomous Institute under Visvesvaraya Technological University, Belagavi)

USN

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Course Code

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Fourth Semester B.E. Degree Examinations, July 2026

**FLUID MECHANICS**

Duration: 3 hrs

Max. Marks: 100

**Note:** 1. Answer any FIVE full questions choosing ONE full Question from each Module.

2. Missing data, if any, may be suitably assumed

| <u>Q. No</u>    | <u>Question</u>                                                                                                                                                                                                                                                                                                                                                    | <u>Marks</u> | <u>(RBT:CO:PI)</u> |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|--------------------|
| <b>Module-1</b> |                                                                                                                                                                                                                                                                                                                                                                    |              |                    |
| 1.              | a. Define viscosity. With a neat sketch explain the phenomenon of viscosity. Derive equation and write the SI and CGS units.                                                                                                                                                                                                                                       | 06           | (1 :1: 1.6.1)      |
|                 | b. Explain the following with figure.<br>(i) Newtonian and Non-Newtonian fluids (ii) Ideal plastic fluids<br>(iii) imaginary and (iv) real fluids.                                                                                                                                                                                                                 | 06           | (2 :1: 1.6.1)      |
|                 | c. The space between two square flat parallel plates is filled with oil, each side of the plate is 720 mm. The thickness of the oil film is 15 mm. the upper plate moves at 3 m/s requires a force of 120 N to maintain the speed. Determine (i) dynamic viscosity of the oil (ii) kinematic viscosity of oil. Take $\mu = 0.95$ for oil.                          | 08           | (3 :1: 1.7.1)      |
| <b>(OR)</b>     |                                                                                                                                                                                                                                                                                                                                                                    |              |                    |
| 2.              | a. Define Pascal's law. With a neat sketch, derive an expression for Pascal's law.                                                                                                                                                                                                                                                                                 | 10           | (2 :1: 1.6.1)      |
|                 | b. The right limb of a simple U-tube manometer containing mercury is open to the atm while the left limb is connected to a pipe in which a fluid of sp. Gravity 0.9 is flowing. The center of the pipe is 12 cm below the level of mercury in the right limb. Find the pressure of fluid in the pipe if the difference of mercury level in the two limbs is 20 cm. | 10           | (3 :1: 1.7.1)      |
| <b>Module-2</b> |                                                                                                                                                                                                                                                                                                                                                                    |              |                    |
| 3.              | a. Define (i) Buoyancy (ii) Centre of Buoyancy (iii) Meta-centre                                                                                                                                                                                                                                                                                                   | 06           | (2 :2: 1.6.1)      |
|                 | b. A Rectangular pontoon is 5 m long, 3 m wide and 1.2 m high. The depth of immersion of the pontoon is 0.80 m in sea water. If the centre of gravity = 0.6 m above the bottom of the pontoon, determine the metacentric height. The density for sea water = $1025 \text{ kg/m}^3$ .                                                                               | 08           | (3 :2: 1.7.1)      |
|                 | c. Find the density of a metallic body which floats at the interface of mercury of sp.gr. 13.6 And water such that 40 % of its volume is submerged in mercury and 60 % in water.                                                                                                                                                                                   | 06           | (3 :2: 1.7.1)      |
| <b>(OR)</b>     |                                                                                                                                                                                                                                                                                                                                                                    |              |                    |
| 4.              | a. Distinguish between (i) steady and unsteady flow (ii) uniform and non-uniform flow (iii) Compressible and in-compressible flow (iv) Laminar and Turbulent flow (v) Rotational and irrotational flow.                                                                                                                                                            | 10           | (2 :2: 1.6.1)      |
|                 | b. A 30 cm diameter pipe conveying water, branches into two pipes of diameters 20 cm and 15 cm respectively. If the average velocity in the 30 cm diameter pipe is 2.5 m/s, find the discharge in this pipe. Also determine the velocity in 15 cm pipe if the average velocity in 20 cm diameter is 2 m/s.                                                         | 10           | (3 :2: 1.7.1)      |
| <b>Module-3</b> |                                                                                                                                                                                                                                                                                                                                                                    |              |                    |
| 5.              | a. Define venturimeter and derive an expression for the discharge through a venturimeter.                                                                                                                                                                                                                                                                          | 10           | (1 :3: 1.6.1)      |

**Note:** (RBT:CO:PI) - Revised Bloom's Taxonomy Level: CO - Course Outcome: PI- Performance Indicator)

|     |    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |    |               |
|-----|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|---------------|
|     | b. | Water is flowing through a pipe having diameter 300 mm and 200 mm at the bottom and upper end respectively. The intensity of pressure at the bottom end is $24.525 \text{ N/cm}^2$ and the pressure at the upper end is $9.81 \text{ N/cm}^2$ . Determine the difference in datum head if the rate of flow through the pipe is $40 \text{ lt/s}$ .                                                                                                                                                                                      | 10 | (3 :3: 1.7.1) |
|     |    | (OR)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |    |               |
| 6.  | a. | Obtain expression for the forced exerted by the jet of water on a fixed vertical plate in the direction of Jet.                                                                                                                                                                                                                                                                                                                                                                                                                         | 10 | (1 :3: 1.6.1) |
|     | b. | A Jet of water of diameter 50 mm strikes a fixed plate in such a way that the angle between the plate and jet is $30^\circ$ . The force exerted in the direction of jet is $1471.5 \text{ N}$ . Determine the rate of flow of water.                                                                                                                                                                                                                                                                                                    | 10 | (3 :3: 1.7.1) |
|     |    | <b>Module-4</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |    |               |
| 7.  | a. | With a neat sketch derive an expression for Darcy-Weisbach equation for head loss due to friction.                                                                                                                                                                                                                                                                                                                                                                                                                                      | 08 | (1 :4: 1.6.1) |
|     | b. | Explain any one minor pipe losses with neat sketches and write the formulae.                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 04 | (2 :4: 1.6.1) |
|     | c. | Determine the rate of flow of water through a pipe of diameter 20 cm and length 50 m when one end of the pipe is connected to a tank and other end of the pipe is opened to the atmosphere. The pipe is horizontal and the height of the water in the tank is 4 m above the centre of the pipe. Consider all minor losses and take $f=0.009$ in Darcy-Weisbach formula. Take $f=0.009$ .                                                                                                                                                | 08 | (3 :4: 1.7.1) |
|     |    | (OR)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |    |               |
| 8.  | a. | Define the following:<br>(i) Laminar boundary layer (ii) Turbulent boundary layer<br>(iii) Laminar- sub layer (iv) Boundary layer thickness<br>(v) The drag force and lift force                                                                                                                                                                                                                                                                                                                                                        | 10 | (2 :4: 1.6.1) |
|     | b. | A man weighing $882.9 \text{ N}$ descends to the ground from an aeroplane with the help of a parachute against the resistance of air. The velocity with which the parachute, which is hemispherical in shape, comes down is $20 \text{ m/s}$ . Find the diameter of the parachute. Assume $C_d = 0.5$ and density of air $= 1.25 \text{ kg/m}^3$ .                                                                                                                                                                                      | 10 | (3 :4: 1.7.1) |
|     |    | <b>Module-5</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |    |               |
| 9.  | a. | What is similitude? Explain types of similitude.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 06 | (2 :5: 1.6.1) |
|     | b. | State Buckingham's $\pi$ theorem.<br>Define the following with examples.<br>(i) Dimensional analysis (ii) Fundamental and derived units<br>(iii) Dimensionally homogeneous equations.                                                                                                                                                                                                                                                                                                                                                   | 06 | (2 :5: 1.6.1) |
|     | c. | The performance of an oil ring consuming a discharge $Q$ of oil depends on the internal diameter of ring $D$ , shaft speed $N$ , density $\rho$ , viscosity $\mu$ , surface tension $\sigma$ , specific weight $\omega$ of the fluid. Find the functional relationship in terms of dimensionless parameters.                                                                                                                                                                                                                            | 08 | (3 :5: 1.7.1) |
|     |    | (OR)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |    |               |
| 10. | a. | With a neat sketch obtain an expression for velocity of sound wave in a fluid.                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 10 | (2 :5: 1.6.1) |
|     | b. | A gas is flowing through a horizontal pipe which is having area of cross-section as $40 \text{ cm}^2$ where pressure is $40 \text{ N/cm}^2$ (gauge) and temperature $15^\circ\text{C}$ . At another section the area of cross section is $20 \text{ cm}^2$ and pressure is $30 \text{ N/cm}^2$ (gauge). If the mass flow rate of the gas through the pipe is $0.5 \text{ kg/s}$ , find the velocities of the gas at these sections, assuming an isothermal change. Take $R = 292 \text{ N-m/kg K}$ , and atm pr $= 10 \text{ N/cm}^2$ . | 10 | (3 :5: 1.7.1) |
|     |    | ** ** *                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |    |               |