

**FLUID MECHANICS**

*Full Marks: 80*

*Time: 3 Hours*

*Answer any five questions including Q.Nos.1 and 2  
Figures in the right-hand margin indicate marks*

**Q1      Answer the following questions:      (2 x 10)**

- a) State Hydrostatic Law.
- b) State the conditions of equilibrium of a floating body.
- c) State relation between gauge pressure, absolute pressure and atm. pressure.
- d) Determine the pressure in bar at a depth of 10 m oil of relative density 0.75.
- e) Why is  $C_d$  of an orifice meter much smaller than that of venturimeter ?
- f) What is the significance of Kinematic viscosity and why we study it though we have dynamic viscosity?
- g) What do you mean by Flow Net, what is its importance?
- h) What is the function of Orifice meter ?
- i) What do you mean by Vacuum pressure?
- j) Define Centre of Buoyancy.

**Q2      Answer any six :      (5 x 6)**

- a) Define hydraulic gradient line and energy gradient line in a pipe with sketch.
- b) Find the density of metallic body which floats at the interface of mercury of specific gravity 13.6 and water such that 40% of its volume is submerged in mercury and 60% in water.
- c) State and explain the conditions of equilibrium of a submerged body.
- d) Classify different types of Manometers.
- e) Draw a neat sketch of velocity diagram showing all components for a jet striking tangentially an unsymmetrical moving curved vane. Draw all three cases of velocity diagram at outlet.
- f) Explain Hydraulic Coefficients.
- g) Derive the equation for  $C_d$  of a venturimeter.
- h) Determine the total pressure and position of centre of pressure on a circular plate of diameter 2m which is placed vertically in water in such a way that the centre of plate is 4m below the free surface of water. Find the position of centre of pressure also?

**Q3      Two tanks containing water are connected by a horizontal pipe of length 25 m and diameter 20 cm. If the difference of water surface in the reservoir is 4 m, find the rate of flow. Also draw the energy gradient line and hydraulic gradient line. Take Darcy's friction factor  $f = 0.01$ .      (10)**

- Q4** A tank 8 m deep and 2m wide is layered with 3 m of oil of  $SG=0.7$  on top , 3 m of water in middle , and 2 m of mercury at bottom. Compute (a) the total hydrostatic force and (b) the resultant centre of pressure of the fluid on the right-hand side of the tank. (10)
- Q5** A simple manometer (U tube) containing mercury is connected to a pipe in which an oil of specific gravity 0.8 is flowing. The pressure in the pipe is vacuum. The other end of the manometer is open to atmosphere. Find the vacuum pressure in the pipe, if the difference of mercury levels in the two limbs is 20 cm and the height of the oil in the left limb from the centre of the pipe is 15 cm below. (10)
- Q6** A solid cylinder of diameter 4m and height 3m .Find the metacentric height of the cylinder when it is floating in water with its axis vertical. The specific gravity of the cylinder is 0.6, State the condition of stability in this case . (10)
- Q7** What is meant by equivalent pipe? Determine the equivalent pipe corresponding to 3 pipes in series with lengths and diameters  $L_1, L_2, L_3, D_1, D_2, D_3$  respectively. (10)

