

**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) List out the minor losses those happen in pipe
- b) Define Centre of Buoyancy.
- 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) State Hydrostatic Law

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

- a) Explain Hydraulic Coefficients.
- 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) A block of wood of specific gravity 0.7 floats in water. Determine the metacentric height of the block if its size is  $2\text{m} \times 1\text{m} \times 0.8\text{m}$ .
- f) Define hydraulic gradient line and energy gradient line in a pipe with sketch.
- g) Define TEL. How it differ from HGL, explain with a sketch.
- h) Derive the equation for  $C_d$  of a venturimeter.
- i) 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 Define Surface tension with a suitable example. The capillary rise in a glass tube is not to exceed 0.2 mm of water. Determine the minimum size of the tube , if surface tension for water in contact with air is  $0.0725\text{N/m}$  (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** A 150mm diameter jet of water moving at 30m/s impinges on a series of vanes moving at 15m/s in the direction of jet and leaves at  $60^\circ$  with the direction of motion of the jet. Calculate (i) force exerted by the jet in the direction of motion of the vanes and (ii) work done by the jet. (10)

