Name :

VIT

Vellore Institute of Technology

(Deemed to be University under section 3 of UGC Act, 1956)

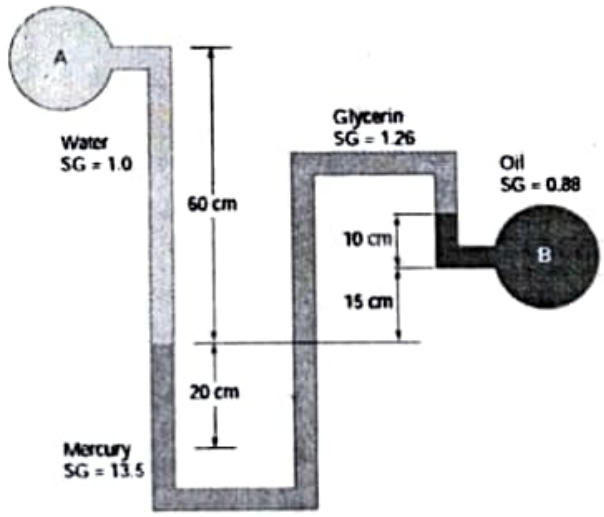
CONTINUOUS ASSESSMENT TEST – I, JANUARY 2023

Programme	:	**B.Tech (Mechanical Engineering)**	Semester	:	**WINTER 2022-23**
			Code	:	**BMEE204L**
Course Title	:	**Fluid Mechanics and Machines**	Class Nbr	:	**CH2022235002421 / CH2022235001659**
Faculty	:	**Dr. M.B. Shyam Kumar / Dr. R. Manimaran**	Slot	:	**D1+TD1**
Time	:	**1 hour and 30 minutes**	Max. Marks	:	**50**

Answer all the Questions (5 x 10 = 50 marks)

Assume data if not mentioned, and state the same in your answer

Q.No.	Sub. Sec.	Question Description	Marks
1.		A horizontal shaft 80 mm in diameter is being pushed through a bearing sleeve 80.2 mm in diameter and 0.3 m long. Both the shaft and sleeve are concentric to each other such that the clearance remains uniform and is flooded with a lubricating oil of viscosity 0.1 kg/ms and specific gravity 0.9. (i) If the shaft moves axially at 0.8 m/s, estimate the resisting force exerted by the oil on the shaft and (ii) If the shaft is axially fixed and rotated at 1800 rpm, estimate the resisting torque exerted by the oil and the power required to rotate the shaft. Draw appropriate schematic sketches to represent the given problem. Neglect the weight of the shaft.	10
2.	a	The pressure difference between an oil pipe and water pipe is measured by a double-fluid manometer, as shown in the figure below. For the given fluid heights and specific gravities, calculate the pressure difference $\Delta P = P_B - P_A$. Avoid redrawing the below figure in your answer sheet to save time.	5



	b	Find the density of a metallic body which floats at the interface of mercury having specific gravity 13.6 and water such that 30% of its volume is submerged in mercury and 70% in water.	5

Given the velocity field

$$\vec{V} = 10x^2y\vec{i} + 15xy\vec{j} + (25t - 3xy)\vec{k}$$

Find the resultant velocity and acceleration of a fluid particle at a point (1,2,-1) and at time, t = 0.5 s. **10**

a The stream function for a two dimensional flow is given by $\psi = 2xy$. Calculate the velocity at the point P(2,3). Find the velocity potential function Φ. **5**

b Find any one component of vorticity at a point (1,1,1) for the following flow field **5**
$\mathbf{u = 2x^2 + 3y,\ v = -2xy + 3y^2 + 3zy,\ w = -(3/2)z^2 + 2xz - 9y^2z}$

a Write down the Bernoulli's equation and state the assumptions made in deriving the same. **3**

b A large tank open to the atmosphere is filled with water up to a height of 5 m from the outlet tap, placed at the bottom. The tap is now opened, and water flows out from the smooth and rounded outlet into the atmosphere. If the outlet pipe cross-sectional area is 0.01 m^2, determine (i) the velocity of water at the outlet by considering necessary assumptions and (ii) the volumetric flow rate of water at the outlet. Draw the schematic sketch to represent the given problem. Neglect all losses. **7**