Enrollment No._____

NAVRACHANA UNIVERSITY

School: School of Engineering and Technology
Program/s: B.Tech Mechanical
Year: 2nd **Semester:** 3rd
Examination: End semester Examination
Examination year: November – 2023

Course Code: ME 207 **Course Name:** Fluid Mechanics I
Date: 21/11/2023 **Total Marks:** 40
Time: 13:00 pm to 15:00 pm **Total Pages:** 02

Instructions:

- *Write each answer on a new page.*
- *Use of a calculator is permitted/not permitted*

Q. No.	Details	Marks	COs*	BTL#
Q.1	**Attempt the following question (Any 03, Each of 06 Marks)** **A.** Derive the Continuity equation in Cartesian co-ordinate for three dimensional flow. The following cases represent the two velocity components, Determine the third component of velocity such that they satisfy the continuity equation. (i) $u = x^2+y^2 + z^2$; $v = xy^2 - yz^2 + xy$ (ii) $v = 2y^2$, $w = 2xyz$ **B.** Find the convection acceleration at the middle of the pipe which converges uniformly from 0.4 m diameter to 0.2 m diameter over the 2m length. The rate of flow changes uniformly from 20 l/s to 40 l/s in 30 seconds; find the total acceleration at the middle of the pipe at 15 th second. **C.** Write the relation between stream function and velocity potential function. The velocity potential function is given by $\Phi = x(2y - 1)$. Determine the velocity at the point P (4, 5). Also determine the value of stream function at the point P. **D.** The pressure difference ΔP in a pipe of diameter D and length L is due to viscus flow depends on velocity V, viscosity μ and density ϱ. Using Buckingham's π theorem obtain an expression for ΔP.	18	CO5 CO6 CO7	BT 1 BT 2 BT 3 BT 4 BT 5
Q.2	**Attempt the following (Any 02, Each of 05 Marks)** **A.** A cylinder having a diameter of 2.4 m and length of 1.95 m is floating in with its axis vertical in sea water (specific weight = 10 kN/m^3). Its weight is 16.5 kN and a load of 1.65 kN is placed centrally at its top. If the cylinder is to remain in stable equilibrium, find the maximum permissible height of the centre of gravity of the load above the top of the cylinder. **B.** As shown in Figure 01, a tank contains water and liquid (specific gravity = 0.9) upto a height of 0.25 m and 0.5 m respectively. Calculate: (i) Total pressure on the side of the tank	10	CO1 CO2 CO3 CO4	BT 1 BT 2 BT 3 BT 4 BT 5

(ii) The position of centre of pressure from one side of the tank which is 1.5 m wide

C. Find the gauge pressure at L and M in Figure 02, if the local atmospheric pressure is 755 mm of mercury.

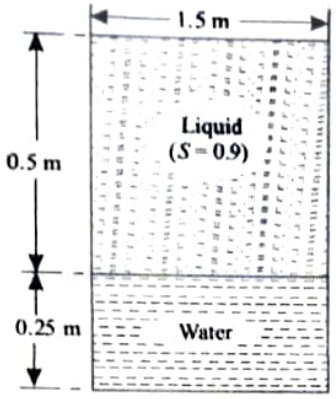

Figure 01

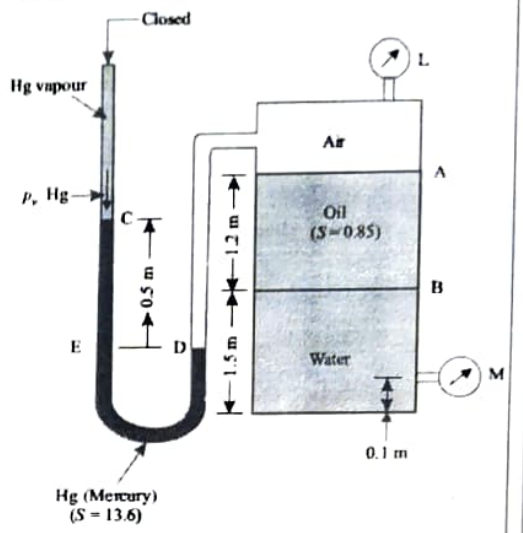

Figure 02

Q.3	**Attempt the following (each of 04 marks)** **A.** The velocity distribution of flow over a plate is parabolic with vertex 30 cm from the plate, where the velocity is 180 cm/s. If the viscosity of the fluid is 0.9 N.s/m^2 find the velocity gradient and shear stress at a distance of 0, 15 cm and 30 cm away from the plate. **B.** Derive an expression for the depth of centre of pressure from free surface of liquid of an inclined plane surface submerged in the liquid. **C.** State and define types of equilibrium of floating bodies. Also mention the condition for these equilibriums.	**12**	CO1 CO2 CO3 CO4	BT 1 BT 2 BT 3 BT 4 BT 5

**********End of Question Paper**********