Indian Maritime University
(A Central University, Govt. Of India)

B. Tech(Marine Engineering)
Semester: 4th
June-2022, End Semester Examinations
Subject Name: FLUID MECHANICS-I
(Subject Code: UG11T3405)

Time: 3 Hours **Max Marks: 70**

Date – 08.06.2022 **Pass Marks: 35**

Part A – Q.No.1; 10 MCQs (10 X 01 Mark)

(I) A fluid is defined as one which

a) cannot withstand shear
b) can withstand shear
c) deforms continuously when subjected to shear stress
d) is solid like when there is no motion

(II) Newton's Law of viscosity states that

a) Shear stress is directly proportional to the velocity
b) Shear stress is directly proportional to the velocity gradient
c) Shear stress is directly proportional to the shear strain
d) Shear stress is directly proportional to the viscosity

(III) Free surface of a liquid tends to contract to the smallest possible area due
to force of

a) Surface Tension
b) Kinematic Viscosity
c) Dynamic Viscosity
d) Momentum Force

(IV) Gauge Pressure at a point is equal to

a) Absolute pressure plus atmospheric pressure
b) Absolute pressure minus atmospheric pressure
c) vacuum pressure plus atmospheric pressure
d) None of the above

(V) Pitot-tube measures the

a) Pressure at point
b) Flow
c) Velocity at a point
d) Discharge

(**VI)** The reason of fluid flow in a pipe is due to

a) Pressure difference only
b) Kinetic energy difference only
c) Potential energy difference only

d) Total Energy Difference

(VII) Bernoulli's equation is conservation of

a) Conservation of mechanical energy for real fluid
b) Conservation of mechanical energy for incompressible fluid
c) Conservation of mechanical energy for Ideal fluid
d) None of the above

(VIII) Spiral Vortex Motion is

a) Combination of vortex and radial flow
b) Irrotational flow
c) Rotational flow
d) None of the above

(IX) The hydraulic gradient line represents the sum of

a) Pressure head and kinetic head
b) Kinetic head and datum head
c) Pressure head, Kinetic head and datum head
d) Pressure head and datum head

(X) In viscous fluid flow in pipe

a) Velocity is maximum at pipe centre
b) Shear stress is minimum at pipe centre
c) Both (a) and (b) are true
d) Both (a) and (b) are false

Part B – Q.No.2; 5 Short Questions (05 X 02 Marks)

(I) Explain the variation of viscosity with temperature.

(II) Explain conditions of equilibrium of a floating body.

(III) Differentiate between steady and uniform flow.

(IV) Define all the hydraulic coefficients and make the relations among them.

(V) What are the different types of losses when fluid flows through pipes.

Part C – 7 Long Questions-Answers Any 5 (05 X 10 Marks)

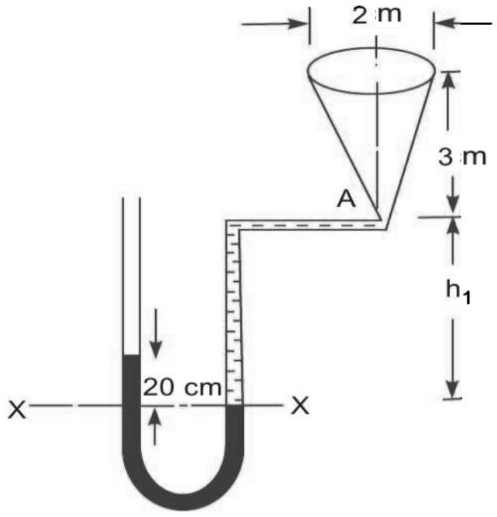
(3)(a) Prove that the capillary rise is directly proportional to the surface tension and inversely proportional to the tube diameter. **[4 Marks]**

(b) The dynamic viscosity of oil, used for lubrication between a shaft and sleeve is 6 poise. The shaft is of diameter 0.4 m and rotates at 190 RPM. Calculate the power lost in the bearing for a sleeve length of 90 mm. The thickness of the oil film is 1.5 mm. **[6 Marks]**

(4)(a) A circular opening, 3m diameter, in a vertical side of a tank is closed by a disc of 3m diameter which can rotate about a horizontal diameter. Calculate (i) the force on the disc, and (ii) the torque required to

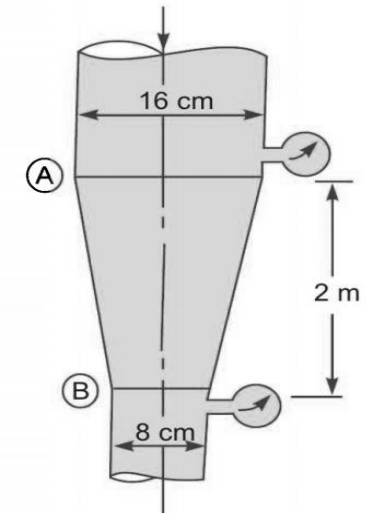
maintain the disc in equilibrium in the vertical position when the head of water above the horizontal diameter is 4 m. **[5 Marks]**

(b) A conical vessel (shown below) having its outlet at A to which a U-tube manometer is connected. The reading of the manometer given in the figure shows when the vessel is empty. Find the manometer reading when the vessel is completely filled with water. **[5 Marks]**



(5)(a) Derive an expression for flow through an Orifice-meter. **[4 Marks]**

(b) In a vertical pipe conveying oil of specific gravity 0.8, two pressure gauges have been installed at A and B where the diameters are 16 cm and 8 cm respectively. A is 2 m above B. The pressure gauge readings have shown that the pressure at B is greater than at A by 0.981 N/cm². Neglecting all losses, calculate the flow rate. If the gauges at A and B are replaced by tubes filled with the same liquid and connected to a U-tube containing mercury, calculate the difference of level of mercury in the two limbs of the U-tube. **[6 Marks]**



(6)(a) Derive the expression for the force and power by the jet on the inclined plate moving in the direction of jet. **[4 Marks]**

(b) The water in a jet propelled boat is drawn amid-ship and discharged at the back with an absolute velocity of 20 m/s. The cross-sectional area of the jet at the back is 0.02 m² and the boat is moving in sea water with a speed of 30 km/hour. Determine: (i) Propelling force on the

boat, (ii) Power required to drive the pump, and (iii) Efficiency of the jet propulsion. **[6 Marks]**

(7)(a) Explain the Darcy's formula and Chezy's formula for finding the head loss due to friction in pipes. **[4 Marks]**

(b) Derive an expression for the head loss due to sudden enlargement of a pipe. **[6 Marks]**

(8)(a) Derive an expression for the power absorbed to overcome the viscous resistance in journal bearing. **[5 Marks]**

(b) A crude oil of viscosity 0.97 poise and density 900 kg/m^3 is flowing through a horizontal circular pipe of diameter 10 cm and length 10 m. Calculate the difference of pressure at the two ends of the pipe, if the 10 kg of oil is collected in a tank in 3 sec. **[5 Marks]**

(9)(a) Derive an expression for the depth of paraboloid formed by the surface of a liquid contained in a cylindrical tank which is rotated at a constant angular velocity about its vertical axis. **[4 Marks]**

(b) Derive an expression for the difference of pressure between two points in a free vortex flow. Does the difference of pressure satisfy Bernoulli's equation? Can Bernoulli's equation be applied to a forced vortex flow? **[6 Marks]**

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