Third Semester B.E. Degree Examination, Feb./Mar. 2022
Fluids Mechanics

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Define fluid. Distinguish between solids, liquids and gases. **(06 Marks)**

b. Define capillarity. Obtain an expression for capillary rise or drop for a given liquid of specific weight 'r_L' and 'd' diameter of glass tube, angle of contact is 'θ', 'σ' represents the surface tension force

$$h = \frac{4\sigma\cos\theta}{r_L \cdot d}$$ **(06 Marks)**

c. A 90 N rectangular solid block slides down a 30° inclined plane. The plane is lubricated by a 3 mm thick film of oil of relative density 0.90 and viscosity 0.8 Ps-sec. If the contact area is 0.3 m^2, estimate the terminal velocity of block. **(08 Marks)**

OR

2 a. The pressure 3m below the free surface of a liquid is 13.72 kN/m^2. Determine its specific weight and relative density. **(06 Marks)**

b. Explain gauge, absolute and vacuum pressure. How do you determine the absolute pressure from the gauge pressure? **(06 Marks)**

c. Find out the differential reading 'h' of an inverted U-tube manometer containing oil of specific gravity 0.7. The manometric liquid when connected across pipes 'A' and 'B' is shown in Fig.Q2(c). Convey liquids of specific gravity 1.2 and 1.0 (water) which are immiscible with manometric liquid. Pipes 'A' and 'B' are located at the same level and assume the pressures at 'A' and 'B' are equal.

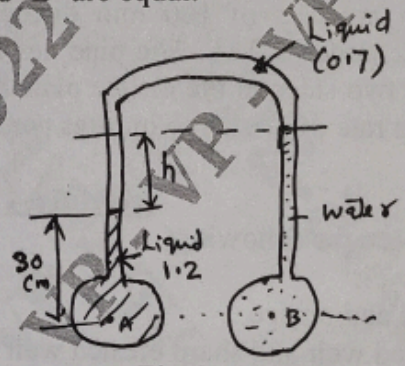

Fig.Q2(c) **(08 Marks)**

Module-2

3 a. Define the following and mention their SI units:
(i) Total Pressure (ii) Centre of pressure (iii) Total acceleration **(06 Marks)**

b. An isosceles triangular plate of base 4m and altitude 4m is immersed vertically in fluid with a specific gravity 0.8. The base of the triangle is touching the top of the surface fluid horizontally and rest of its portion is within the fluid. Determine the total pressure and centre of pressure of the plate from the top liquid level. **(08 Marks)**

c. Write short notes on: (i) Lagrangian method (ii) Eulerian method (iii) Flow net **(06 Marks)**

OR

4 a. A cylindrical gate is 3m long and has water on its both sides as shown in Fig.Q4(a). Determine the magnitude and direction of the resultant hydrostatic force exerted on the gate.

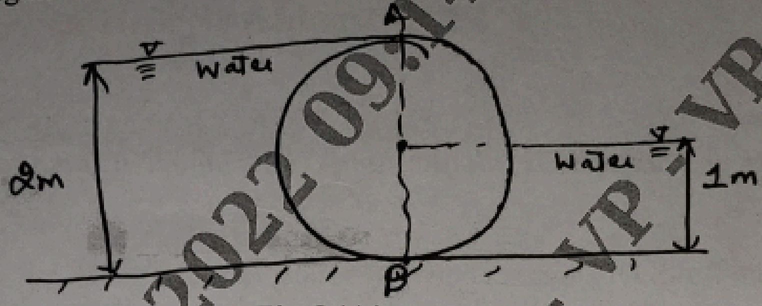

Fig.Q4(a) **(08 Marks)**

b. Distinguish between:
   (i) Steady flow and unsteady flow
   (ii) Rotational flow and irrotational flow **(04 Marks)**

c. If $\phi = 3xy$, find x and y components of velocity at (1, 3) and (3, 3). Determine the discharge passing between streamlines passing through these points. **(08 Marks)**

Module-3

5 a. State and prove Euler's equation of motion and derive Bernoulli's energy equation from it. Mention the assumptions. **(10 Marks)**

b. For the horizontal venturimeter of 150 mm × 75 mm, determine the reading of the mercury manometer, if the pipe carries 40 LPS of water. Given $C_d = 0.97$. Sp.Gr. mercury = 13.6. **(10 Marks)**

OR

6 a. 300 LPS of water is flowing in a pipe having diameter of 300 mm. If the pipe is bent by 120°, find the magnitude and direction of the resultant force on the bend. The pressure of the water flowing is 400 kN/m^2. Take specific weight of water = 9.81 kN/m^3. **(08 Marks)**

b. With a neat sketch, describe the construction and working of a pitot tube. **(06 Marks)**

c. An orifice meter consists of 100 mm diameter in a 300 mm diameter pipe having a coefficient of discharge of 0.65. The pipe delivers oil of relative density 0.9. The pressure difference on the two sides of the orifice plate measured by mercury differential manometer is 70 cm. Find the rate of discharge in litres per second. **(06 Marks)**

Module-4

7 a. Distinguish between the following:
   (i) Notch and weir
   (ii) Mouthpiece and orifice
   (iii) Broad crested weir and sharp crested weir
   (iv) Triangular notch and Cipolletti notch **(08 Marks)**

b. Explain the classification of Notches and Weirs. **(06 Marks)**

c. A discharge of 0.08 m^3/sec was measured over a 60° angled notch. While measuring the head over notch an error of 2 mm was made. Determine the percentage error in discharge if the coefficient of discharge for the notch is 0.6. **(06 Marks)**

OR

8 a. Oil flows through a 25 mm diameter orifice under a head of 5.5 m at a rate of 3 LPS. The jet strikes a wall 1.5 m away and 120 mm vertically below the centerline of the contracted jet. Calculate the coefficients of velocity, contraction and discharge. **(06 Marks)**

b. A trapezoidal notch has a base width of 0.75 m and a side slope of 1 horizontal to 2 vertical. Calculate the discharge over the notch for a head of 0.50 m by assuming $C_d = 0.63$. **(06 Marks)**

c. Write a short note on ventilation of Weirs mentioning its type and effect on discharge measurement. **(08 Marks)**

Module-5

9 a. Derive an expression for the loss of head due to sudden expansion in the pipe. **(08 Marks)**

b. Explain Hardy Cross method for pipe network analysis. **(06 Marks)**

c. A cast iron pipe ($E = 1.0 \times 10^{11}$ Pa) is a 0.9 m in diameter and carries water ($K = 2.0 \times 10^{9}$ Pa) at a velocity of 2.6 m/s. A valve in this pipe is instantaneously closed bringing the flow to a sudden stop at the valve end. Estimate the water hammer head produced due to this action. The pipe thickness is 1.25 cm and the pipe can be treated as elastic. **(06 Marks)**

OR

10 a. A 6 cm diameter pipe has a discharge of water of 450 Litres/minute. At a section the pipe has a sudden expansion to a size of 9 cm diameter. If the pressure just upstream of the expansion is 20 KN/m^2, calculate the pressure just after the expansion. Assume the pipe to be horizontal. Given $r_w = 9.81$ kN/m^3. **(06 Marks)**

b. Explain the following terms with a neat sketch:

(i) Pipes in series
(ii) Total energy line
(iii) Water Hammer in pipes
(iv) Hydraulic gradient line **(08 Marks)**

c. The velocity of water in a 60 cm diameter and 1.5 cm thick cast iron pipe ($E = 1.04 \times 10^{11}$ Pa) is changed from 3 m/sec to zero in 0.8 sec by closure of a valve. What will be the corresponding pressure rise if given bulk modulus of elasticity of water is 2.11×10^{9} N/m^2. **(06 Marks)**

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