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Third Semester B.E. Degree Examination, Jan./Feb. 2021
Fluid Mechanics

Time: 3 hrs.

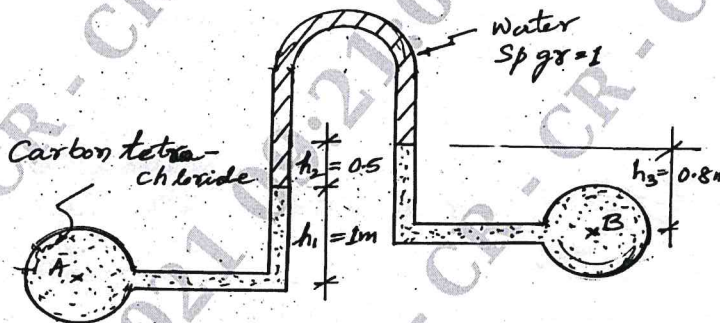
Max. Marks:100

Note: Answer any FIVE full questions, selecting atleast TWO questions from each part.

PART - A

1. a. Define the terms : i) Mass density ii) Specific weight iii) Specific volume
iv) Specific gravity v) Compressible fluid vi) Incompressible fluid. (06 Marks)
 - b. Explain the types of fluids (classification) with examples. (08 Marks)
 - c. Define Surface tension. Prove that the relationship between surface tension and pressure inside the droplet of a liquid in excess of outside pressure is given by $P = \frac{4\sigma}{d}$. (06 Marks)
2. a. State and prove Pascal's law. (08 Marks)
 - b. Calculate pressure due to column of : i) 0.5m of water
ii) 0.5m of oil of specific gravity 0.8 iii) 0.5m of mercury of specific gravity 13.6.
Specific weight of water = 9810 N/m^3 , If atmospheric pressure = 0.103 N/mm^2 , calculate absolute pressure in each of the above case. (06 Marks)
 - c. Using an inverted U – tube manometer, find the intensity of pressure at 'B' for the given condition shown in Fig. Q2(c). Carbon tetrachloride of relative density 1.6 is flowing through the pipe A and B. Water is used as manometer fluid. The pressure at A is 294.33 kN/m^2 . (06 Marks)

Fig. Q2(c)



3. a. Define Total pressure and Centre of pressure. (04 Marks)
 - b. A rectangular plane surface 2m wide and 3m deep lies in water in such a way that its plane makes an angle of 30° with free surface of water. Determine the total pressure and position of centre of pressure when the upper edge is 1.5m below and 2m wide plane is parallel to the free liquid surface. (08 Marks)
 - c. A Tank $2\text{m} \times 2\text{m} \times 2\text{m}$ is filled with water upto 0.8m height from bottom and remaining height is filled with an oil of specific gravity 0.8. Determine total pressure on one side of the tank and position of the centre of pressure. (08 Marks)
4. a. Explain Eulerian and Lagrangian methods of representing the fluid flow. (04 Marks)
 - b. Derive the three – dimensional continuity equation in the Cartesian co-ordinates. (08 Marks)
 - c. The velocity components in a 2 – D flow field for an incompressible fluid are as follows :
 $u = \frac{y^3}{3} + 2x - x^2y$ and $V = xy^2 - 2y - \frac{x^3}{3}$. Obtain expression for the stream function Ψ (Psi) (08 Marks)

PART - B

- 5 a. Derive the Bernoulli's energy equation from the Euler's motion equation, mentioning clearly the assumption made in the derivation. (08 Marks)
- b. Water is flowing through a pipe having diameter 350mm and 150mm at the bottom and upper end respectively. The intensity of pressure at the bottom end is 30N/cm^2 and the pressure at the upper end is 15N/cm^2 . Determine the difference in datum head if the rate of flow through pipe is 50lts/sec. (06 Marks)
- c. A pipe of 200mm diameter conveying $0.18\text{m}^3/\text{sec}$ of water has a 90° bend in a horizontal plane. The pressure intensities at the inlet and outlet of the bend are 290 KPa and 280 KPa. Find the resultant force exerted by water on the bend. (06 Marks)
- 6 a. What do you understand by the terms : i) Major energy loss and Minor energy losses in pipes ii) Total energy line and hydraulic gradient line iii) Pipes in series and pipes in parallel. (06 Marks)
- b. Derive an expression for the loss of energy (head) due to friction in pipes. (08 Marks)
- c. Water has to be supplied to a town of 4,25,000 inhabitants. The reservoir is 6km from the town. The head lost in the pipe line due to friction is measured as 12.5m. Find the size of the supply main if each inhabitant consumes 180 litres of water per day and one half the daily supply is pumped in 8 hours. Take $f = 0.0075$. (06 Marks)
- 7 a. Write short notes on : i) Self recording gauge ii) Staff gauges iii) Weight gauge iv) Float gauges. (12 Marks)
- b. What is Current meter? Explain the method of measuring the discharge across the stream. (04 Marks)
- c. A pitot tube is used to gauge the flow of turpentine in a pipe line. The two tappings of the pitot tube are connected to a differential U - tube manometer. If the manometer liquid is mercury and the difference of mercury level is 120mm, what is the velocity? Take specific gravity of turpentine = 0.86. The coefficient of the pitot tube is 0.975. (04 Marks)
- 8 a. Derive an expression for discharge over a rectangular notch in terms of head of water over the crest of the notch. (08 Marks)
- b. During a test in a laboratory, the water which has passed through a venturimeter flows over a right angled triangular notch, the larger diameter of the venturimeter is 250mm and the diameter at the throat 100mm. When the steady head over the notch is 182mm is maintained , the difference of pressure head at the venturimeter is found to be 0.339m. Determine the co-efficient of discharge of venturimeter taking C_d of notch = 0.6. (06 Marks)
- c. The head of water over an orifice of diameter 10cm is 10m. The water coming out from orifice is collected in a circular tank of diameter 1.5m. The rise of water level in this tank is 1m in 25 secs. Also the co-ordinates of a point on the jet, measured from vena – contracta are 4.3m horizontal and 0.5m vertical. Find the co-efficient of C_d , C_v , C_c . (06 Marks)

