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18CV33

Third Semester B.E. Degree Examination, June/July 2024
Fluid 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 the following and mention their units:
   i) Dynamic Viscosity
   ii) Specific gravity
   iii) Cohesion and Adhesion
   iv) Specific weight. **(08 Marks)**
   b. State Newton's law of viscosity and obtain relation between stress and strain with a neat sketch. **(06 Marks)**
   c. The right limb of a simple U-tube manometer containing mercury is open to atmosphere while the left limb is connected to a pipe in which a fluid of sp. gravity 0.9 is flowing. The centre of the pipe is 12cm below the level of mercury in the right limb. Find the pressure of fluid in the pipe if the difference of mercury level in the two limbs is 20cm. **(06 Marks)**

OR

2 a. State and prove Hydrostatic law. **(06 Marks)**
   b. What are pressure gauges? Explain working of Bourdan Tube pressure gauge with a neat sketch. **(08 Marks)**
   c. An oil of 1.5mm thick film is used for lubrication between a square plate of size 0.9m x 0.9m and an inclined plane having an angle of 20° inclination. The weight of square plate is 392.4N and it slides down the plane with uniform velocity of 0.2m/s. Find the dynamic viscosity of oil. **(06 Marks)**

Module-2

3 a. Derive an expression for total pressure and centre of pressure for a vertical plane surface submerged in the liquid. **(08 Marks)**
   b. Explain velocity potential function and stream function and give their properties. **(06 Marks)**
   c. A circular plate 2.5m diameter is immersed in water, its greatest and least depth below the free surface being 3m and 1m respectively. Find : i) The total pressure on one face of the plate   ii) The position of the centre of pressure. **(06 Marks)**

OR

4 a. List the types of fluid flow. Explain any two of them. **(06 Marks)**
   b. With a neat sketch explain water pressure on gravity dam. **(06 Marks)**
   c. Water flows through a pipe AB 1.2m diameter at 3m/s and then pass through a pipe BC 1.5m diameter. At C the pipe branches into CD and CE, pipe CD is 0.8m diameter and carries 1/3 of flow in AB and velocity in branch pipe CE is 2.5m/s. Find the volume rate of flow in AB, the velocity in BC, CD and diameter of pipe CE. **(08 Marks)**

Module-3

5 a. Derive Bernoullis equation from Eulers equation of motion also state assumptions and limitations of Bernoullis equation. **(08 Marks)**

   b. Write a note on pitot tube. **(04 Marks)**

   c. A venturimeter has its axis vertical, the inlet and throat diameter being 15cm and 7.5cm respectively. The throat is 22.5cm above inlet and Cd = 0.96. The fluid is petrol of specific gravity 0.78 and it flows up through the meter at a rate of $0.029 m^3/s$. Find the pressure difference between inlet and throat. **(08 Marks)**

OR

6 a. What is venturimeter? Derive an expression for discharge through a horizontal venturimeter. **(08 Marks)**

   b. Derive an expression for force exerted by a flowing fluid on a pipe bend. **(06 Marks)**

   c. The water is flowing through a taper pipe of length 100m having its diameter 600mm at the upper end and 300mm at lower end, at the rate of 50 lit/s. The pipe has a slope of 1 in 30. Find the pressure at the lower end if the pressure at the higher level is $19.62 N/cm^2$. **(06 Marks)**

Module-4

7 a. What is an orifice? List the classification of orifice. Obtain an expression for discharge through a small discharging free orifice. **(08 Marks)**

   b. What is Mouthpiece? How they are classified? Comment on why discharge is high in a mouthpiece than that of orifice of same diameter. **(06 Marks)**

   c. The head of water over a trapezoidal notch is 20cm, bottom width and top width (flow width) of notch are 0.4m and 1.0 m and height of notch is 30cm. Find the discharge through the notch, if cd for rectangular and triangular portions as 0.62 and 0.60 respectively. **(06 Marks)**

OR

8 a. Derive an expression for discharge through a rectangular notch. **(06 Marks)**

   b. What is a weir? How they are classified? Derive an expression for discharge through a broad crested weir. **(08 Marks)**

   c. A jet of water issuing from an orifice 25mm diameter under a constant head of 1.5m falls 0.915m vertically before it strikes the ground at a distance of 2.288m measured horizontally from the vena contracta. The discharge was found to be 102LPM. Calculate the hydraulic co-efficients of the orifice. **(06 Marks)**

Module-5

9 a. Drive an expression for pressure rise due to sudden closure of valve when pipe is rigid. **(08 Marks)**

   b. Explain about pipes in parallel and equivalent pipe. **(06 Marks)**

   c. A pipe system consist of three pipes arranged in series, the length of pipes are 1200m, 750m and 600m and diameters of 750mm, 600mm and 450mm respectively
   i) Transform the system into an equivalent pipe of 450mm diameter.
   ii) Determine equivalent diameter of pipe, 2250m long. **(06 Marks)**

OR

10 a. Explain the phenomenon of water hammer in pipes. List the factors governing it. **(06 Marks)**

   b. Derive Darcy's Weisbacti equation for head loss in pipes due to friction. **(08 Marks)**

   c. The water is flowing with a velocity of 1.5m/s in a pipe of length 2500m and of diameter 50cm. At the end of the pipe a valve is provided. Find the rise in pressure if the valve is closed in 25 seconds. Take the value of C = 1460m/s. **(06 Marks)**

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