10CV35

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

Fluid Mechanics

Time: 3 hrs.   Max. Marks:100

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

PART – A

1   a.   Define the following fluid properties, give their dimensions:
        (i) Specific weight   (ii) Dynamic viscosity   (iii) Relative density
        (iv) Capillarity   (v) Surface tension   (vi) Specific gravity   **(12 Marks)**
    b.   Determine the intensity of shear of an oil having viscosity = 1 poise. The oil is used for lubricating the clearance between a shaft of diameter 10 cm and its journal bearing. The clearance is 15 mm and the shaft rotates at 150 rpm.   **(08 Marks)**

2   a.   Derive equation for hydrostatic law of pressure variation.   **(06 Marks)**
    b.   With the help of a neat sketch, define the terms absolute, gauge and vacuum pressure. Bring out the relation between absolute and gauge pressure.   **(08 Marks)**
    c.   Petrol of specific gravity 0.8 flows up through a vertical pipe. A and B are the two points in the pipe, B being 0.3 m higher than A. Connections are led from A and B to a U-tube manometer containing mercury. If the pressure difference between A and B is 18 kPa, find the routing of differential manometer.   **(06 Marks)**

3   a.   Define : (i) Total pressure   (ii) Centre of pressure   **(04 Marks)**
    b.   Derive an expression for the depth of centre of pressure from the free surface of liquid of an inclined plane surface submerged in the liquid.   **(08 Marks)**
    c.   A rectangular plate 2m wide and 3m depth is immersed in water such that its ends are at depth of 1.5 m and 3m respectively. Determine the total pressure acting on the plate and locate centre of pressure.   **(08 Marks)**

4   a.   Distinguish between:
        (i)   Steady and unsteady flow
        (ii) Uniform and non-uniform flow
        (iii) Compressible and incompressible flow   **(06 Marks)**
    b.   Derive the continuity equation in Cartesian coordinates for steady, in compressible, three dimensional laws.   **(08 Marks)**
    c.   The velocity potential function for a two dimensional flow is $\phi = x(2y-1)$ at point p(3.4), determine:
        (i) The velocity at that point
        (ii) The value of stream function   **(06 Marks)**

PART – B

5   a.   Derive Bernoulli's equation from the Euler's equation for a steady flow of fluid and list the assumptions made in it.   **(10 Marks)**
    b.   A 45° reducing bend is connected in a pipe line. The diameters at the inlet and outlet of the bend being 600 mm and 300 mm respectively. Find the force exerted by water on the bend if the intensity of pressure at inlet bend is 8.829 N/cm^2 and rate of flow of water is 600 liter/sec.   **(10 Marks)**

6 a. Derive the Darcy-Weisbach equation for head loss due to friction in pipe. **(08 Marks)**

b. List major and minor losses in pipe with expressions. **(04 Marks)**

c. Water is flowing in a pipe 150 mm diameter with a velocity of 2.5 m/sec when it is suddenly brought to rest by closing the valve. Find the pressure rise in the pipe assuming it to be elastic with $E = 206$ GN/m^2 and Poisson's ratio = 0.25. The bulk modulus of water $K = 206$ GN/m^2, thickness of pipe wall is 5 mm. **(08 Marks)**

7 a. Write short notes on:
   (i) Staff gauge
   (ii) Weight gauge
   (iii) Float gauge
   (iv) Self recording gauge **(08 Marks)**

b. Explain with the help of a neat sketch, the working of cup type current meter. Give the equation for finding the velocity of flow using current meter. **(08 Marks)**

c. A pitot tube is used to measure the velocity of water in a pipe. The stagnation pressure head is 6m and static pressure head is 5m. Calculate the velocity of flow assuming the coefficient of pitot tube = 0.98. **(04 Marks)**

8 a. Distinguish between:
   (i) Venturimeter and orificemeter
   (ii) Rectangular and triangular notch
   (iii) Ogee weir and broad crested weir **(06 Marks)**

b. Derive the equation of discharge over a triangular notch. **(08 Marks)**

c. Find the discharge over a rectangular weir of length 100 m. The head of water over the weir is 1.5 m, the velocity of approach is given as 0.5 m/sec. Take $C_d = 0.6$. **(06 Marks)**

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