CBCS Scheme

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15CV33

Third Semester B.E. Degree Examination, June/July 2017
Fluid Mechanics

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Define the following with symbols and units:
i) Mass density ii) Specific weight **(04 Marks)**

b. Derive expression for Newton's law of viscosity and state. **(06 Marks)**

c. A cylindrical shaft of 90 mm dia rotates about a vertical axis inside a fixed cylindrical tube of length 50 cm and 95 mm internal dia. If the space between the tube and the shaft is filled by a lubricant of dynamic viscosity 8.0 poise. Determine the power required to overcome viscous resistance, when the shaft is rotated at a speed of 240 rpm. **(06 Marks)**

OR

2 a. Explain the working of a Bourdan's pressure gauge with a diagram. **(04 Marks)**

b. State and prove Pascal's law. **(06 Marks)**

c. Fig.Q2(c) shows a differential manometer connecting two points A and B. Pipe A contains carbon tetrachloride of specific gravity 1.594 under a pressure of 1.05 kgf/cm^2 and pipe B contains oil of specific gravity 0.8 under a pressure of 1.75 kgf/cm^2. If the manometer liquid is mercury, find the difference 'x' between the mercury levels.

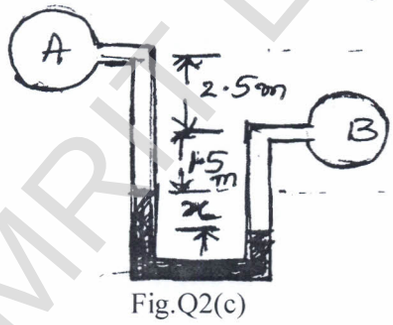

Fig.Q2(c) **(06 Marks)**

Module-2

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. **(06 Marks)**

c. A rectangular plane surface 1 m wide and 3 m deep lies in water in such a way that its plane makes an angle of 30° with the free surface of water. Determine the total pressure and the depth of centre of pressure when the upper edge of the plate is 2 m below the free surface. **(06 Marks)**

OR

4 a. Define: i) Uniform and non-uniform flow, ii) steady and unsteady flow. **(04 Marks)**

b. Derive the three dimensional continuity equation in the Cartesian coordinates. **(06 Marks)**

c. The stream function for a two dimensional flow is $\Psi = 2x^2 - 2y^2$. Find:
i) Resultant velocity at point (1, 3).
ii) Velocity potential function. **(06 Marks)**

Module-3

5 a. Define momentum equation and give its applications. **(03 Marks)**

b. State the Bernoulli's theorem. Derive the Bernoulli's equation starting from Euler's equation of motion along a stream line. **(06 Marks)**

c. A 45° reducing bend is connected in a pipeline, the diameters at the inlet and outlet are 600 mm and 300 mm respectively. Find the force exerted by the water on the bend if the intensity of pressure at inlet to bend is 88.29 kN/m^2 and rate of flow of water is 0.6 m^3/sec. **(07 Marks)**

OR

6 a. Define: i) Forced vortex, ii) Free vortex. Give one example each. **(04 Marks)**

b. Derive an expression for the discharge through a venturimeter. **(06 Marks)**

c. The water is flowing through a tapering pipe of length 50 cm, having dia 40 cm at the upper end and 20 cm at the lower end at the rate of 60 ℓps. The pipe has a slope of 1 in 40. Find the pressure at the lower end, if the pressure at the higher end is 24.525 N/cm^2. **(06 Marks)**

Module-4

7 a. Define the hydraulic coefficients (C_c, C_d, C_v) of an orifice and obtain the relation between them. **(05 Marks)**

b. Derive the expression for discharge through a small orifice of area 'a' under a head 'h' measured above the centre of the orifice. **(05 Marks)**

c. Water discharges freely at a rate of 98 ℓps through a 120 mm dia vertical sharp edged orifice under a constant head of 10 m of water. A point on the jet measured from the venacontracta has coordinates (+4.5m, –0.54m). Find hydraulic coefficients. **(06 Marks)**

OR

8 a. Explain ventilation of weirs. **(04 Marks)**

b. Derive the expression for discharge through a triangular notch. **(06 Marks)**

c. Find the discharge through a trapezoidal notch which is 1m wide at the top and 0.40 m at the bottom and is 30 cm in height. The head of water on the notch is 20 cm. given C_d for rectangular portion = 0.62 and C_d for triangular portion = 0.60. **(06 Marks)**

Module-5

9 a. Explain: i) Pipes in parallel, ii) Pipes in series. **(04 Marks)**

b. Derive Darcy Weisbach expression for the loss of head due to friction in pipes. **(06 Marks)**

c. A pipe 50 mm diameter is 6 m long and the velocity of flow of water in the pipe is 2.4 m/sec. What loss of head and the corresponding power would be saved if the central 2 m length of pipe was replaced by 75 mm diameter pipe, the change of section being sudden? Take 4f = 0.04 for pipes of both diameters. **(06 Marks)**

OR

10 a. Explain the terms hydraulic gradient and total energy lines. **(04 Marks)**

b. Derive the expression for pressure rise due to sudden closure of valve when the pipe material is elastic. **(05 Marks)**

c. For a pipe network shown in Fig.Q10(c), determine the flow in each pipe. The value of n may be assumed as 2.0.

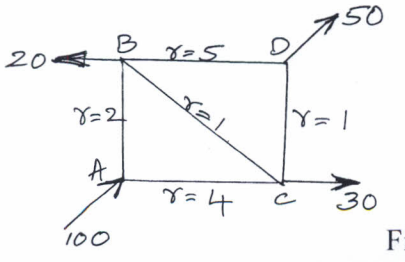

Fig.Q10(c) **(07 Marks)**