CBCS SCHEME

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17CV33

Third Semester B.E. Degree Examination, Aug./Sept.2020
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. Distinguish between:
(i) Ideal fluids and real fluids
(ii) Surface tension and capillarity
(iii) Absolute pressure and gauge pressure
(iv) Newtonian and non Newtonian fluids **(10 Marks)**

b. Calculate the dynamic viscosity of oil which is used for lubrication between a square plate 0.8 × 0.8 m size and inclined plane with angle of inclination of 30°. The weight of square plate is 300 N and it slides down the inclined plane with a uniform velocity of 0.3 m/s the thickness of oil film is 1.5 mm. **(06 Marks)**

c. An oil of specific gravity is 0.8 under a pressure of 137.2 kN/m^2. What is the pressure head (i) expressed in metre of water (ii) expressed in metre of oil? **(04 Marks)**

OR

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

b. Calculate the capillary rise in a glass tube of 2.5 mm diameter when immersed vertically in (i) water (ii) mercury. Take surface tension σ = 0.0725 N/m for water and σ = 0.52 N/m for mercury. For mercury angle of contact = 130°. **(06 Marks)**

c. A simple U – tube manometer containing mercury is connected to a pipe in which a fluid of specific gravity 0.8 and having vacuum pressure is flowing. The other end of the manometer is open to atmosphere. Find the vacuum pressure in pipe. If the difference of mercury level in the two limbs is 40 cm and the height of fluid in the left from the centre of pipe is 15 cm below. **(08 Marks)**

Module-2

3 a. Derive an expression for total pressure and center of pressure for a vertical plane surface submerged in the liquid. **(08 Marks)**

b. If for a two-dimensional potential flow, the velocity potential is given by $\phi = x(2y - 1)$. Determine the velocity at the point P(4, 5). Also determine the value of stream function ψ at the point P. **(06 Marks)**

c. Determine the total pressure on ac circular plate of diameter 1.5 m which is placed vertically is water in such a way that the centre of plate is 3m below the free surface of water. Find also the position of centre of pressure. **(06 Marks)**

OR

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

b. Find the total pressure and position of centre of pressure on a triangular plate of base 2m and height 3m which is immersed in water in such a way that the plane of the plate makes an angle of 60° with the free surface of the water. The base of the plate is parallel to water surface and at a depth of 2.5 m from water surface. **(08 Marks)**

c. The velocity components in a two dimensional flow are $u = \frac{y^3}{3} + 2x - x^2y$ and $v = xy^2 - 2y - \frac{x^3}{3}$. Show that these components represent a possible case of an irrotational flow. **(06 Marks)**

Module-3

5 a. State the Bernoulli's theorem. Derive the Bernoulli's equation starting from Euler's equation of motion along a stream line. **(08 Marks)**

b. Define: (i) Forced vortex (ii) Free vortex with examples. **(04 Marks)**

c. The inlet and throat diameters of a horizontal venturimeter are 30 cm and 10 cm respectively. The liquid flowing through the venturimeter is water. The pressure intensity at inlet is 13.734 N/cm^2 while the vacuum pressure head at the throat is 37 cm of mercury. Find the rate of flow. Take $C_d = 0.98$. **(08 Marks)**

OR

6 a. Derive an expression for the discharge through a venturimeter. **(08 Marks)**

b. 250 l/s of water flowing in a pipe having a diameter of 300 mm. If the pipe is bend by 135° (i.e. change from initial to final direction is 135°). Find the magnitude and direction of the resultant force on the bend, when the pressure of water flowing is 39.24 N/cm^2. **(08 Marks)**

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

Module-4

7 a. Define hydraulic coefficients and obtain the relation between them. **(06 Marks)**

b. Differentiate between : (i) Notch and Weir (ii) Orifice and mouth piece **(06 Marks)**

c. A rectangular weir of crest length 50 cm is used to measure the rate of flow of water in a rectangular channel of 80 cm wide and 70 cm deep. Determine the discharge in the channel if the water level is 80 mm above the crest of weir. Take velocity of approach into consideration, $C_d = 0.62$. **(08 Marks)**

OR

8 a. Derive an expression for discharge through a triangular notch. **(08 Marks)**

b. A right angled V-notch is used for measuring a discharge of 30 l/s. An error of 1.5 mm was made while measuring the head over the notch. Calculate the percentage error in discharge $C_d = 0.62$. **(06 Marks)**

c. The head of water over an orifice of diameter 100 mm is 10 m. 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 1.0 m in 25 seconds. Also the coordinates of a point on the jet, measured from vena contracta are 4.3 m horizontal and 0.5m vertical. Find the hydraulic coefficient of orifice. **(06 Marks)**

Module-5

9 a. Explain: (i) Equivalent pipe (ii) Pipe in parallel (iii) Pipe in series **(06 Marks)**

b. A pipe of diameter 20 cm and length 2000 m connects two reservoirs, having difference of water levels as 20 m. Determine the discharge through the pipe, if an additional pipe of diameter 20 cm and length 1200 m is attached to the last 1200 m of length of the existing pipe. Find the increase in discharge. Take f = 0.015 and neglect minor losses. **(10 Marks)**

c. Explain water hammer in pipes. **(04 Marks)**

OR

10 a. Explain minor losses. Give expression for head loss due to :
(i) Sudden expansion (ii) Major loss. **(06 Marks)**

b. A valve is provided at the end of a cast iron pipe of diameter 150 mm and of thickness 10 mm. The water is flowing through the pipe which is suddenly stopped by closing the valve. Find the maximum velocity of water when the rise of pressure due to sudden closure of valve is 196.2 N/cm^2. Take K for water as 19.62×10^4 N/cm^2 and E for cast iron pipe as 11.772×10^6 N/cm^2. **(06 Marks)**

c. Explain:
(i) Hydraulic gradient line and total energy line
(ii) Hardy cross method
(iii) Gradual closure of valve **(08 Marks)**

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