CBCS SCHEME

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17CV33

Third Semester B.E. Degree Examination, Dec.2019/Jan.2020

Fluid Mechanics

Time: 3 hrs. Max. Marks: 100

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

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. Define the following with symbols and units:
i) Mass density ii) Specific weight iii) Specific gravity. **(06 Marks)**

b. An oil film of thickness 1.5mm is used for lubrication between a square plate of size 0.9m × 0.9m and an inclined plane having an angle of inclination 20°. The weight of the square is 392.4N and it slides down the plane with a uniform velocity of 0.2m/s. Find the dynamic viscosity of the oil. **(06 Marks)**

c. Find the manometer reading 'h' for the Fig.Q.1(c) shown below. **(08 Marks)**

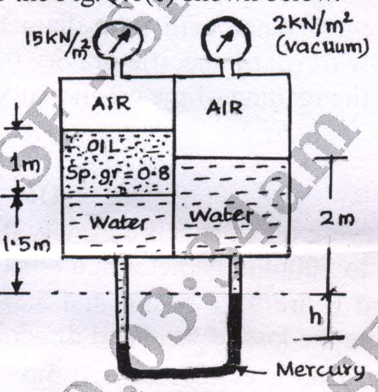

Fig.Q.1(c)

OR

2 a. The surface tension of water in contact with air is given as 0.0725 N/m. The pressure outside the droplet of water of diameter 0.02mm is atmospheric (10.32 N/cm^2). Calculate the pressure within the droplet of water. **(04 Marks)**

b. A shaft of diameter 120mm is rotating inside a journal bearing of diameter 122mm at a speed of 360rpm. The space between the shaft and the bearing is filled with a lubricating oil of viscosity 6 poise. Find the power absorbed in oil if the length of bearing is 100mm. **(08 Marks)**

c. State and prove the Pascal's law. **(08 Marks)**

Module-2

3 a. Derive an expression for the force exerted on a submerged vertical plane surface by the static liquid and locate the position of centre of pressure. **(10 Marks)**

b. In a two-dimensional incompressible flow, the fluid velocity components are given by $u = x - 4y$ and $v = -y - 4x$. Show that velocity potential exists and determine its form. Find also the stream function. **(10 Marks)**

OR

4 a. What are the methods of describing fluid flow? Explain briefly. **(04 Marks)**

b. Define the equation of continuity. Obtain an expression for a three-dimensional continuity equation in Cartesian coordinate system. **(08 Marks)**

c. Find the magnitude and direction of the resultant water pressure acting on a curved face of a dam which is shaped according to the relation $y = x^2/9$ as shown in Fig.Q.4(c). The height of the water retained by the dam is 10m. Consider the width of the dam as unity. **(08 Marks)**

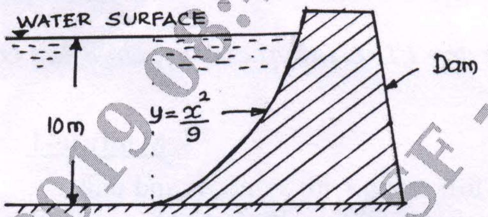

Fig.Q.4(c)

Module-3

5 a. State Bernoulli's theorem. Derive an expression for Bernoulli's theorem from first principle and state the assumptions made for such a derivation. **(10 Marks)**

b. A horizontal venturimeter with inlet diameter 30cm and throat diameter 15cm is used to measure the flow of oil of specific gravity 0.8. The discharge of oil through venturimeter is 50 litres/s, find the reading of the oil-mercury differential manometer. Take $C_d = 0.98$. **(10 Marks)**

OR

6 a. A pipe line carrying oil of specific gravity 0.87, changes in diameter from 200mm diameter at a position A to 500mm diameter at a position B, which is 4 metres at a higher level. If the pressures A and B are 9.81 N/cm^2 and 5.886 N/cm^2 respectively and the discharge is 200 litres/s determine the loss of head and direction of flow. **(10 Marks)**

b. A 45° reducing bend is connected in a pipe line, the diameters at the inlet and outlet of the bend being 40cm and 20cm respectively. Find the force exerted by water on the bend if the intensity of pressure at inlet of bend is 21.58 N/cm^2. The rate of flow of water is 500 litres/s. **(10 Marks)**

Module-4

7 a. Define an orifice and a mouthpiece. What are hydraulic coefficients? Explain them. **(06 Marks)**

b. The head of water over an orifice of diameter 40mm is 10m. Find the actual discharge and actual velocity of the jet at vena-contracta. Take $C_d = 0.6$ and $C_v = 0.98$. **(04 Marks)**

c. Water flows over a rectangular weir 2m wide at a depth of 200mm and afterwards passes through a triangular right-angled weir. Take C_d for the rectangular and triangular weir as 0.63 and 0.59 respectively, find the depth over the triangular weir. **(10 Marks)**

OR

8 a. Derive an expression for the discharge over a triangular notch. **(10 Marks)**

b. The head of water over an orifice of diameter 100mm is 5m. The water coming out from orifice is collected in a circular tank of diameter 2m. The rise of water level in circular tank is 0.45m in 30 seconds. Also the coordinates of a certain point on the jet, measured from vena-contracta are 100cm horizontal and 5.2cm vertical. Find the hydraulic coefficients c_α, c_v and c_c. **(10 Marks)**

Module-5

9 a. Derive Darcy-Weisbach equation for head loss due to friction in a pipe. **(10 Marks)**

b. The rate of flow of water through a horizontal pipe is 0.25 m^3/s. The diameter of the pipe which is 200mm is suddenly enlarged to 400mm. The intensity pressure in smaller pipe is 11.772 N/cm^2. Determine:

i) Loss of head due to sudden enlargement
ii) Pressure intensity in large pipe
iii) Power lost due to enlargement. **(10 Marks)**

OR

10 a. A pipe line of 0.6m diameter is 1.5km long. To increase the discharge, another line of the same diameter is introduced parallel to the first in the second half of the length. Neglecting minor losses, find the increase in discharge if 4f = 0.04. The head at inlet is 300mm. **(10 Marks)**

b. Explain the phenomenon of water hammer. Obtain an expression for the rise of pressure when the flowing water in a pipe is brought to rest by sudden closure of valve and pipe is elastic. **(10 Marks)**

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