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Fourth Semester B.E. Degree Examination, Dec.2023/Jan.2024 Fluid Mechanics and Hydraulics

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 fluid properties and mention their SI units : i) Specific weight
ii) Kinematic viscosity iii) Surface tension. (06 Marks)
- b. Define Capillarity of a liquid. Derive an expression for the capillary rise of a liquid. (06 Marks)
- c. A cube of 0.25m side and mass 28kg slides down a plane inclined at 2 vertical : 3 Horizontal covered by a thin film of oil of viscosity 2.2×10^{-3} N-S/m². If the thickness of the film is 0.02mm, determine the steady state velocity of the block. (08 Marks)

OR

- 2 a. Derive an expression for total pressure and centre of pressure for an immersed vertical plane surface. (06 Marks)
- b. State the prove Pascal's law of pressure. (06 Marks)
- c. A differential manometer is connected at two points A and B as shown in Fig. Q2(c). At B, the air pressure is 9.81N/cm² (absolute). Find the absolute pressure at A. (08 Marks)

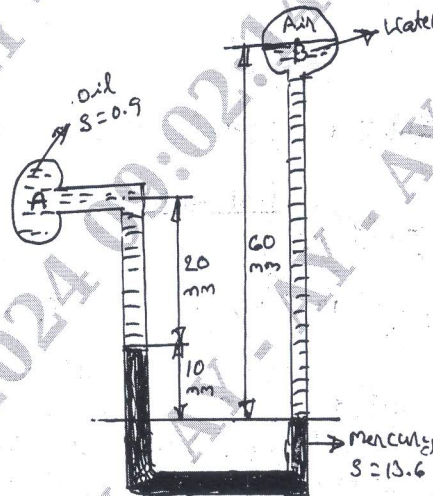


Fig. Q2(c)

Module-2

- 3 a. Derive Euler's equation of motion along a stream line. Obtain Bernoulli's equation from Euler's equation. Mention the assumptions made. (10 Marks)
- b. A pipe 300m long has a slope of 1 : 100 and tapers from 1m diameter at the higher end to 0.5m at the lower end. The quantity of water flowing is 0.9m³/s. If the pressure at the higher end is 70kPa , find the pressure in kPa at the lower end. (10 Marks)

OR

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.

- 4 a. Derive the three dimensional continuity equations for a steady, incompressible fluid flow. (08 Marks)
- b. Derive an expression for discharge through a venturimeter with usual notations. (08 Marks)
- c. Mention the reasons for the following :
- The coefficient of discharge if a venturimeter is always greater than that of an orifice order.
 - The divergent portion of a venturimeter is made longer than the convergent cone. (04 Marks)

Module-3

- 5 a. Explain the classification of Notches and Weirs. (04 Marks)
- b. Derive an expression for discharge through a rectangular notch with usual notations. (06 Marks)
- c. The head of water over a circular shape vertical orifice of diameter 100mm is 10m. The water coming out from the orifice is collected in a circular measuring tank of diameter 1.5m. The time recorded for 1m rise of water in the measuring tank is 25 seconds. The coordinates of the jet measured from the Vena – contract are 4.3m horizontal and 0.5m vertical. Determine the hydraulic coefficients of the orifice. (10 Marks)

OR

- 6 a. Explain the experimental method of determination of the three hydraulic coefficients of a small circular vertical orifice discharging water from a tank if the head over the orifice is H. (08 Marks)
- b. Determine the discharge through a trapezoidal notch which is 1m wide at top and 0.4m at the bottom. The head of water above the sill level is 0.2m and the total height of the notch is 0.3m. Consider the coefficient of discharge for the rectangular portion as 0.62 and for triangular portion as 0.6. (06 Marks)
- c. Determine the head loss due to friction in a pipe of diameter 300mm and length 50m through which water is flowing at a velocity of 3m/s. Use Darcy – Weisbach equation. Take kinematic viscosity of water as 0.01 stokes. (06 Marks)

Module-4

- 7 a. Explain the classification of flows in open channels with necessary conditions. (06 Marks)
- b. A rectangular channel carries water at the rate of 400 litres/s with the bed slope maintained at 1 vertical : 2000 horizontal. Find the most economical dimensions of the channel if the Chezy's constant = 50. (08 Marks)
- c. Determine the specific energy of flowing water through a rectangular channel of width 5m having a discharge of $10\text{m}^3/\text{s}$ and depth of flow of 3m. (06 Marks)

OR

- 8 a. Explain the concept of hydraulic jump with the aid of a neat sketch. Write the expression for evaluating the depth of the hydraulic jump. (05 Marks)
- b. Determine the critical depth and critical velocity of water flowing through a rectangular channel of width 8m carrying a discharge of $15\text{m}^3/\text{s}$. (05 Marks)
- c. Determine the slope of the bed of the circular channel for maximum velocity condition. The diameter of the channel is 0.6m through which water is flowing at a rate of 150 litres/s. Take Chezy's constant = 60. (10 Marks)

Module-5

- 9 a. Derive an expression for the force exerted by a jet striking a moving symmetrical curved lane at the centre and hence show that the maximum efficiency of this jet – lane system is limited to $\frac{16}{27}$. (10 Marks)
- b. Explain the classification of hydraulic turbines and define the different efficiencies of the same. (10 Marks)

OR

- 10 a. With the help of a neat sketch, explain the function of different parts of a Francis inward flow reaction turbine. (10 Marks)
- b. A centrifugal pump is to deliver $0.12\text{m}^3/\text{s}$ of water at a speed of 1450 rpm against a head of 25m. The impeller diameter is 250mm and the width at outlet is 50mm. the manometric efficiency is 75%. Determine the vane angle at the outer periphery of the impeller. (10 Marks)
