CBCS SCHEME

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18MR46

Fourth Semester B.E. Degree Examination, Dec.2023/Jan.2024
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. Derive an equation for capillary rise and capillary fall. **(06 Marks)**

b. What is surface tension? Derive an equation for surface tension on liquid droplet. **(06 Marks)**

c. The spaces between two square flat parallel plates is filled with oil. Each side of the plate is 600m. The thickness of the oil film is 12.5mm. The upper plate, which mass at 2.5 meter per sec requires a force of 98.1 V to maintain the speed determine.

i) The dynamics viscosity of the oil in pose and

ii) The kinematic viscosity of the oil in stokes if the specific gravity of the oil is 0.95. **(08 Marks)**

OR

2 a. Define :

i) Absolute pressure ii) Gauge pressure iii) Vacuum pressure. **(06 Marks)**

b. Determine equation for Pascal's law. **(06 Marks)**

c. A differential monometer is connected at the two points A and B of two pipes of shown in Fig. Q2(c). The pipe a contains a liquid of specific gravity = 1.5 while pipe B contains of a specific gravity 0.9. The pressure at A and B at 1Kgf/cm^2 and 1.80 Kgf/cm^2 respectively. Find the difference in mercury level in the differential monometer.

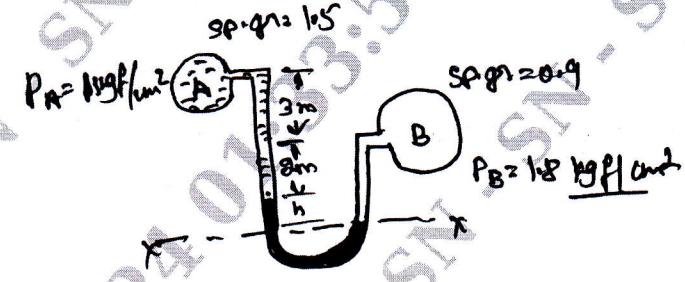

Fig Q2(c) **(08 Marks)**

Module-2

3 a. Derive continuity equation in three dimensions. **(10 Marks)**

b. Water flows through a pipe AB 1:2m diameter at 3m/s and then passes through a pipe BC 1.5m diameter. At C, the pipe branches. Branch CD is 0.8m in diameter and carries one third of the flow in AB. The flow velocity in branch CE is 2.5m/s. Find the volume rate of flow in AB the velocity in BC, the velocity in CD and the diameter of CE. **(10 Marks)**

OR

4 a. State Bernoulli's theorem for steady state flow of an incompressible fluid. Derive an expression for Bernoulli's equation from first principle and state the assumptions made for such a derivation. **(10 Marks)**

b. The water is glowing through a pipe having diameters 20cm and 10cm at sections 1 and 2 respectively. The rate of flow through pipe is 35 liters/s. The section 1 is 6m above datum and section 2 is 4m above datum. If the pressure at section 1 is 39.24N/cm^2, find the intensity of pressure at section 2. **(10 Marks)**

Module-3

5 a. What is venturimeter? Derive an expression for rate of flow through venturimeter. **(10 Marks)**

b. An orifice meter with orifice diameter 10cm is inserted in a pipe of 20cm diameter. The pressure gauges fitted upstream and downstream of the orifice meter gives readings of 19.62N/cm^2 and 9.81N/cm^2 respectively. Coefficient of discharge for the meter is given as 0.6. Find the discharge of water through pipe. **(10 Marks)**

OR

6 a. Define the following :
i) Dimensionless number ii) Reynold's number iii) Froude's number iv) Eulers number v) Weber's number vi) Mach's number. **(06 Marks)**

b. State and prove Buckingham's π-theorem. **(06 Marks)**

c. A pipe of diameter 1.5m is required to transport in oil of specific gravity 0.90 and viscosity 3×10^{-2} poise at the rate of 3000 litre/s. Lists were conducted on a 15cm diameter pipe using water at 20°C.Find the velocity and rate of flow in the model. Viscosity of water at 20°C = 0.01 poise. **(08 Marks)**

Module-4

7 a. Derive Darcy-Weisbach equation for loss of head due to friction in pipes. **(10 Marks)**

b. The rate of flow of water through a horizontal pipe is 0.25m^3/s. The diameters of the pipe which is 200mm is suddenly enlarged to 400mm. The pressure intensity in the smaller pipe is 11.772 N/cm^2. Determine :
i) Loss of head due to sudden enlargement
ii) Pressure intensity in the large pipe
iii) Power lost due to enlargement **(10 Marks)**

OR

8 a. Derive Hagen Poiseuille equation. **(10 Marks)**

b. A crude oil of viscosity poise and relative density 0.9 is flowing through a horizontal circular pipe of diameter 100mm and of length 10m. Calculate the difference of pressure at the two ends of the pipe, if 100kg the oil is collected in a tank in 30 seconds. Assume laminar flow. **(10 Marks)**

Module-5

9 a. Derive an equation for drag and lift. **(06 Marks)**

b. Define : i) Drag ii) Lift **(04 Marks)**

c. Experiments were conducted in a wind tunnel with a wind speed to 50Km/hr on a flat plate of size 2m long and 1m wide. The density of air is 1.15Kg/m^3. The coefficients of lift and drag are 0.75 and 0.15 respectively. Determine :
i) Lift force ii) Drag force iii) Resultant force iv) Direction of resultant force v) power exerted by air on plate. **(10 Marks)**

OR

10 a. Define the following :
i) Laminar boundary layer
ii) Boundary layer thickness
iii) Displacement thickness **(06 Marks)**

b. What is mach number in a fluid flow? What are the types of fluid flow based in mach number? Explain. **(06 Marks)**

c. Find the sonic velocity for the following fluids.
i) Crude oil of specific gravity 0.8 and bulk modulus 153036 N/cm^2
ii) Mercury having a bulk modulus of 2648700N/cm^2. **(08 Marks)**