CBCS SCHEME

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18CV33

Third Semester B.E. Degree Examination, June/July 2023
Fluid Machines

Time: 3 hrs. Max. Marks: 100

Note: *1. Answer any FIVE full questions, choosing ONE full question from each module.*
2. Missing data, if any, may be suitably assumed.

Module-1

1 a. Define the following and give the SI units :
i) Dynamic viscosity
ii) Surface tension
iii) Mass density
iv) Weight density **(06 Marks)**

b. Derive expression for capillary rise and fall in a liquid. **(06 Marks)**

c. A closed tank contains air, turpentine and bromine as indicated in Fig.Q1(c). Determine gauge pressure at the bottom of tank. Also express this pressure interms of mm of mercury. Assume atmospheric pressure as 103KPa. The specific gravity of bromine is 3.1 and that of turpentine is 0.7. The air pressure in the top of the tank is measured as 25KPa vaccum. Also express bottom pressure in absolute pressure.

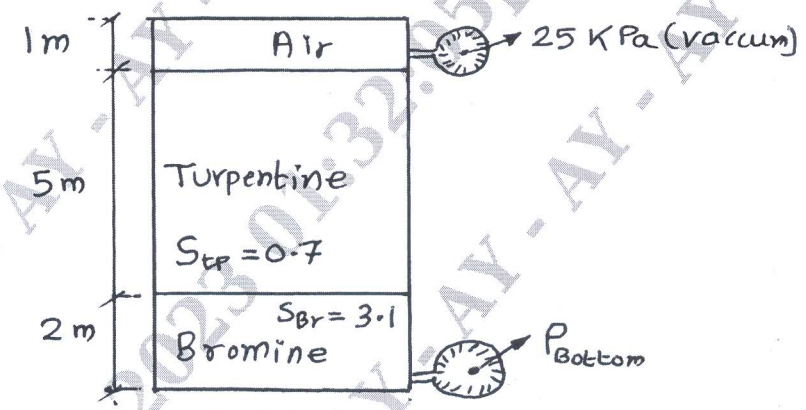

Fig.Q1(c) **(08 Marks)**

OR

2 a. Derive an expression for variation of static pressure with depth inside a static mass of fluid. **(06 Marks)**

b. Derive expression for finding pressure difference between two points using differential manometer. **(06 Marks)**

c. A shaft of diameter 400mm rotates inside a bearing of length 100mm with 200rpm. The lubricant thickness is 1.4mm, being used in the arrangement. The dynamic viscosity of lubricant is 0.7 Pa –sec. Determine the torque and power required to overcome the viscous resistance. **(08 Marks)**

Module-2

3 a. Derive an expression for total pressure and location of center of pressure for a vertically submerged plane surface. **(08 Marks)**

b. A circulate plate of 2.5m diameter is immersed in water in such a way that the greatest and least depths are 3m and 1m respectively. Determine the total pressure on one face and location of center of pressure from free surface. **(08 Marks)**

c. Determine the location of the centre of pressure for a dam shown in Fig.Q3(c) using pressure diagram method. Height of the water behind dam is 5m and width of the dam is 20m. Also find the value of total pressure.

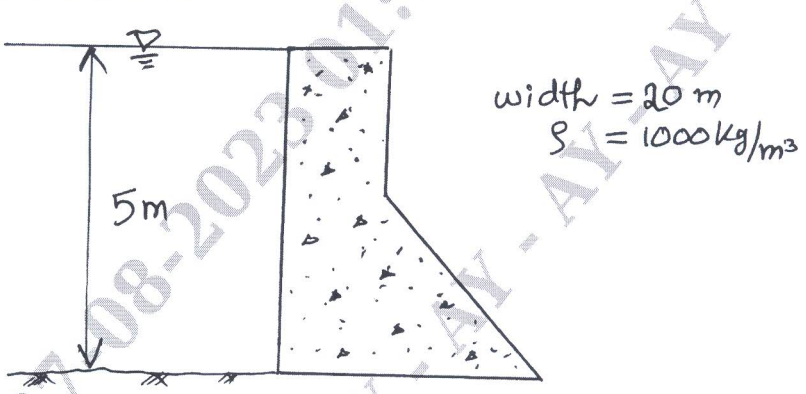

Fig.Q3(c) **(04 Marks)**

OR

4 a. Derive continuity equation for one dimensional flow. **(04 Marks)**

b. Prove that equipotential lines are orthogonal to stream lines at all points of intersection. **(08 Marks)**

c. In a 2 – D flow the velocity potential ϕ is given by $\phi = x[2y - 1]$. Determine the velocity at point P(4, 5). Also determine the value of stream function ψ at the point 'P'. **(08 Marks)**

Module-3

5 a. Derive Euler's equation of motion and then obtain Bernoulli's equation. State the assumptions and limitation of Bernoulli's theorem. **(10 Marks)**

b. A converging pipe of 0.3m diameter at inlet and 0.15m diameter at outlet carries a water flow. Inlet is 6m above datum and outlet is 1m above the datum. Inlet pressure is $1.5 \times 10^5 N/m^2$ and inlet velocity is 5m/s. Determine the outlet velocity and pressure. Neglect the losses. **(05 Marks)**

c. 250 LPS of water is flowing in a pipe having diameter 0.3m. The pipe is bent by 135° with respect to initial flow direction. Determine the magnitude and direction of the resultant force on the bend. Take water pressure as 392.4KPa. **(05 Marks)**

OR

6 a. A 0.3m × 0.15m venturimeter is fixed in a vertical pipeline carrying oil of specific gravity 0.9, the flow being upwards. The difference between elevation of throat and inlet of venturimeter is 0.3m. The U – tube differential manometer shows a gauge deflection of 0.25m. Determine the oil flow rate in the pipe line and pressure difference between inlet and throat. $C_d = 0.98$ and specific gravity of mercury is 13.6. Draw the necessary diagram. **(10 Marks)**

b. Briefly explain the working principle of orificemeter with a sketch. **(05 Marks)**

c. A sub-marine moves horizontally in sea and has its axis 15m below the surface of water. A pitot tube is placed in front of the submarine and along its axis is connected to the two limbs of U-tube containing mercury. The difference of mercury level is 170mm. Find the speed of the sub-marine, assuming specific gravity of mercury as 13.6 and that of sea water as 1.026 with respect to fresh water. **(05 Marks)**

Module-4

7 a. Derive an expression for discharge through a triangular notch. **(06 Marks)**

b. Give various classifications of orifice and mouthpiece. **(06 Marks)**

c. A jet of water coming from an orifice of 25mm diameter under a heat of 1.5m falls vertically 0.915m before it strikes the ground at a distance of 2.288m measured horizontally from vena – contracta. The flow rate is 102 LPM. Determine the hydraulic coefficients. **(08 Marks)**

OR

8 a. Derive expression for hydraulic coefficients of an orifice using Jet distance measurement method. **(06 Marks)**

b. Briefly explain :

i) Cipolleti notch

ii) Ventilation of notch. **(06 Marks)**

c. A rectangular weir of crest length 0.5m is used to measure flow rate in a rectangular channel of 0.8m wide and 0.7m deep. Water level is 80mm above weir crest. Determine the flow rate in the channel. Use velocity of approach method. $C_d = 0.62$. Consider one trial. **(08 Marks)**

Module-5

9 a. Derive Darcy – Weisbach equation for friction loss in a pipe. **(08 Marks)**

b. Briefly explain :

i) Major loss

ii) Minor loss

iii) Hydraulic gradient line **(04 Marks)**

c. The water is flowing in a pipe with velocity 1.5m/s, having length 2500m and diameter 500mm. Find the rise in pressure in the pipe of valve closed in : i) 25 seconds ii) 3 second. Assume C = 1460 m/s. **(08 Marks)**

OR

10 a. Briefly explain the term water hammer in pipes. **(06 Marks)**

b. Derive an expression for pressure rise in a pipe when valve is gradually closed. **(06 Marks)**

c. Three pipes of 400mm, 200mm and 300mm diameter have lengths of 400m, 200m and 300m respectively. These pipes are connected in series to form a compound pipe. The ends of pipes are connected to two tanks with a difference in water levels of 16m. The friction coefficient is 0.005 for all pipes. Determine the discharge in the compound pipe by neglecting minor losses. **(08 Marks)**

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