Ref. No.: Ex/PROD/PC/B/T/211/2025

B.E. PRODUCTION ENGINEERING SECOND YEAR FIRST SEMESTER EXAM 2025

Subject: FLUID MECHANICS AND MACHINES

Time: 3 hours **Fullmarks:100**

Answer any five questions

1. (a) The tip of the glass tube with an internal diameter of 2 mm is inverse to a depth of 1.5 cm into a liquid of specific gravity 0.85. Air is forced into the tube to form a spherical bubble just at the lower end of the tube. Find the surface tension of liquid, if the air pressure inside the bubble is 200 N/m^2. (CO1)

   (b) A differential manometer connects the two points A and B of two pipes as shown in figure 1. Pipe A contains a liquid of specific gravity = 1.5 while pipe B contains a liquid of specific gravity = 0.9. The pressure at A and B are 1 kgf/cm^2 and 1.80 kgf/cm^2 respectively. Find the difference in mercury level in the differential manometer. (CO1)

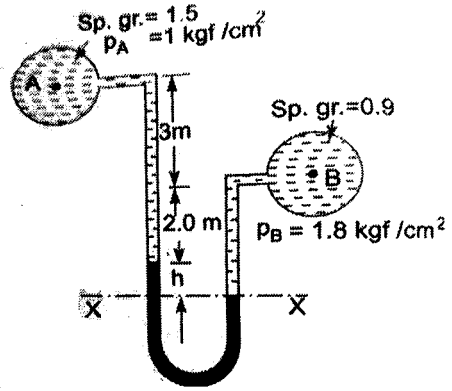

Fig.1

   (c) A pipeline carrying oil of specific gravity 0.87, changes in diameter from 200 mm diameter at a position A to 500 mm diameter at a position B which is 4 meters at a higher level. If the pressures at A and B are 9.81 N/cm^2 and 5.886 N/cm^2 respectively and the discharge is 200 liters/s. determine the loss of head and direction of flow. **(5+7+8 = 20)** (CO2)

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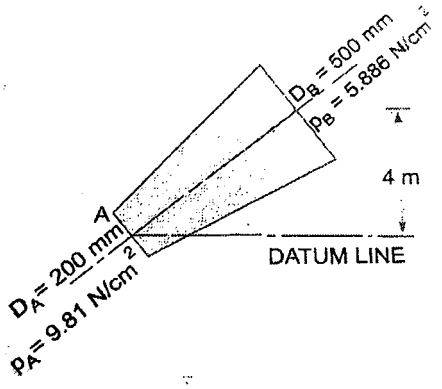

Fig.2

2. (a) A vessel, cylindrical in shape and closed at the top and bottom, contains water up to a height of 80 cm. The diameter of the vessel is 20 cm and the length of vessel is 120 cm. The vessel is rotated at a speed of 400 rpm about it vertical axis. Find the height of the paraboloid formed. (CO2)

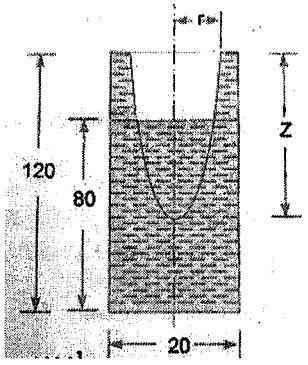

Fig.3

(b) A cylinder 3 meters in diameter and 4 meters long retains water on one side. The cylinder is supported as shown in the figure. Determine the horizontal reaction at A and the vertical reaction at B. The cylinder's weight is 196.2 KN, ignore the friction. (CO2)

(10 +10 =20)

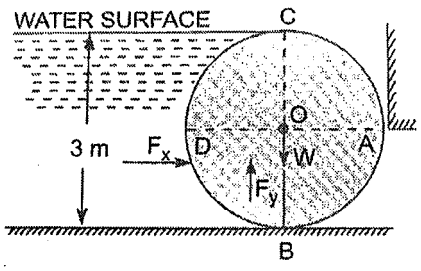

Fig.4

3. (a) Explain the (i) Lamina flow, (ii) Turbulent flow (iii) non-uniform flow. (CO2)

(b) Water flows through a pipe AB 1.2 m diameter at 3 m/s and then passes through a pipe BC 1.5 m diameter. At C, the pipe branches. Branch CD is 0.8 m in diameter and carries one-third of the flow in AB. The flow velocity in branch CE is 2.5 m/s. Find the volume rate of flow in AB, the velocity in BC, the velocity in CD and the diameter of CE. (CO2)

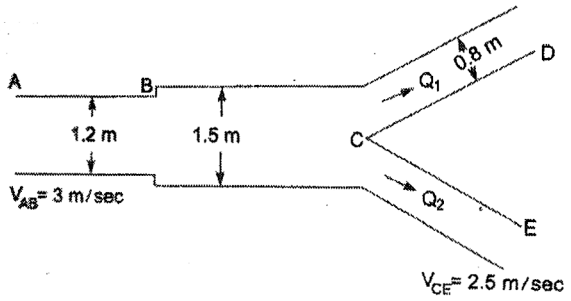

Fig.5

(c) The stream function for a two-dimensional flow is given by $\Psi = 2xy$. Calculate the velocity at a point P (2,3). Find the velocity potential function ø. (CO3) **(5+7+8 = 20)**

4. (a) Discussed the relation between steam function and velocity potential function. What are those properties obtaining from steam function? . (CO2)

(b) Prove that $\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} = 0$, from three dimensional continuity equation. (CO3)

(c) A 30 cm x 15 cm venturimeter is provided in a vertical pipe line carrying oil of specific gravity 0.9, the flow being upwards. The difference in elevation of the throat section and the entrance of the venturimeter is 30 cm. The differential U-tube mercury manometer shows a gauge deflection of 25 cm. Calculate:

(i) The discharge of oil, and

(ii) the pressure difference between the entrance section and the throat section. Take the co-efficient of discharge as 0.98 and the specific gravity of mercury as 13.6. (CO3) **(4+7+9=20)**

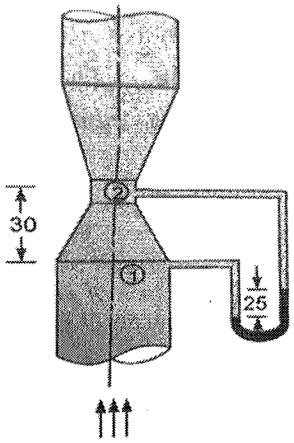

Fig.6

5. (a) An oil of specific gravity 0.9 and viscosity 0.06 poise is flowing through a pipe of diameter 200 mm at the rate of 60 liters/s. find the head loss due to friction for a 500 m length of pipe. Find the power required to maintain this flow. (CO4)

   (b) Derive Chezy's formula for loss of head due to friction in the pipe. (CO4)

   (c) Distinguished between venturi meter and orifice meter. (CO4) **(7+9+4 =20)**

6. (a) Explain the layout of the hydroelectric power plant. What are the parameters required to design the Pelton wheel? (CO5)

   (b) Explain Thoma's cavitation factors for centrifugal pumps. Write down the effects of cavitation for centrifugal pumps. (CO5)

   (b) A Pelton wheel is to be designed for the following specifications:
   Shaft power = 11,772 KW; Head = 380 meters; speed = 750 rpm; overall efficiency= 86%; jet diameter is not to exceed one-sixth of the wheel diameter. Determine:

   (i) The wheel diameter,

   (ii) The number of jets required,

   (iii) Diameter of the jet. (take $K_{V1=0.985}$ and $K_{u1=0.45}$)

   (c) Define the slip for the reciprocating pump. **(7+10+3=20)**

7. A pelton wheel is working under a gross head of 400 m. The water is supplied through penstock of diameter 1 m and length 4 km from reservoir to the pelton wheel. The co-efficient of friction for the penstock is given as 0.008. The jet of water of diameter 150 mm strikes the buckets of the wheel and gets deflected through an angle of 165^0, the relative velocity of water at outlet is reduced by 15% due to friction between inside surface of the bucket and water. If the velocity of the bucket is 0.45 times the jet of velocity an inlet and mechanical efficiency as 85%. Determined:

   (i) Power given to the runner
   (ii) Shaft power
   (iii) Hydraulic efficiency and overall efficiency. (CO5)

   (b) As inward forward reaction turbine has external and internal diameters as 1.0 m and 0.6 m respectively. The hydraulic efficiency of the turbine is 90% when the head of the turbine is 36 m. The velocity of flow at outlet is 2.5 m/s and the discharge at outlet is radial. If the vane angle at outlet is 15^0 and the width of the wheel is 100 mm at inlet and outlet, determine: (i) the guide blade angle, (ii) speed of the turbine, (iii) vane angle of the runner at inlet, (iv) volume flow rate of turbine and (v) power developed. (CO5) **(10+10=20)**