Ref. No.: Ex/PROD/PC/B/T211/2024(S)

B.E. PRODUCTION ENGINEERING SECOND YEAR FIRST SEMESTER SUPPLEMENTARY EXAM 2024

Subject: FLUID MECHANICS AND MACHINES

Time: 3 hours **Fullmarks:100**

Answer any five questions

1. (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 lose due to friction for a 500 m length of pipe. Find the power required to maintain this flow.

(b) A differential manometer is connecting at the two points A and B of two pipes as shown in the figure 1. The 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.

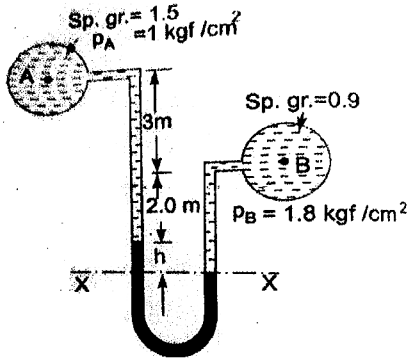

Fig.1

(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)**

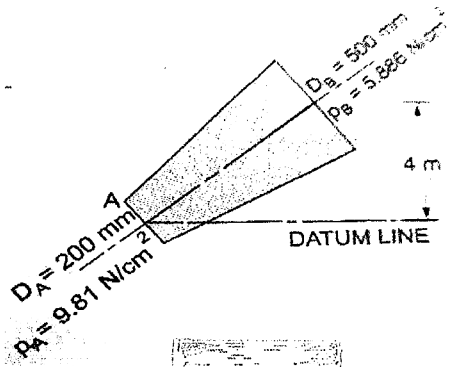

Fig.2

[Turn over

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 paraboloid formed.

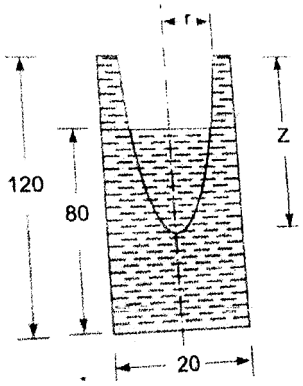

Fig.3

(b) The figure shows a gate having a quadrant shape of radius 2 m. Find the resultant force due to water per meter length of the gate and also find the angle at which total force will act. **(10 +10 =20)**

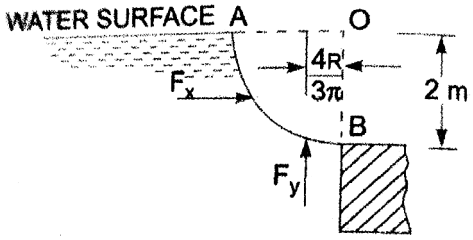

Fig.4

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

(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.

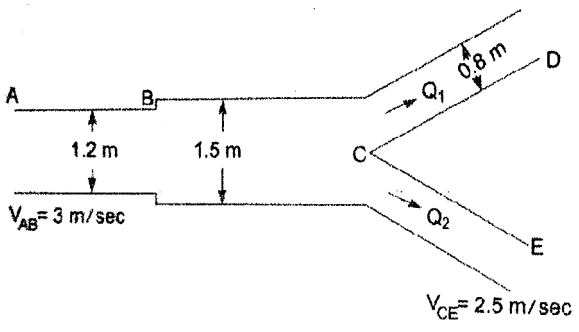

Fig.5

(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. **(6+7+7 = 20)**

4. (a) Discussed the relation between steam function and velocity potential function. What are those properties obtaining from steam function? Prove that $\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} = 0$, from three dimensional continuity equation.

(b) 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. **(8+12=20)**

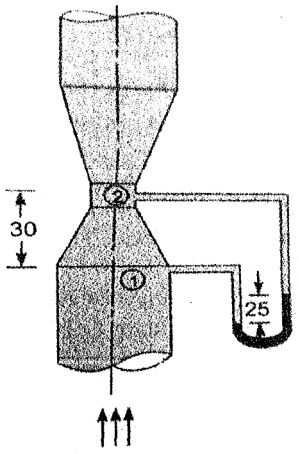

Fig.6

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

(b) A pitot tube is inserted in a pipe of 300 mm diameter. The static pressure in pipe is 100 mm in mercury (vacuum). The stagnation pressure at the centre of the pipe, recorded by the pitot-tube is 0.981 N/cm^2. Calculate the rate of flow of water through pipe, if the mean velocity of flow is 0.85 times the central velocity. Take C_V=0.98.

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

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

(b) A horizontal pipe of diameter 500 mm is suddenly contracted to a diameter of 250 mm. the pressure intensities in the large and smaller pipe is given as 13.734 N/cm^2 and

11.772 N/cm^2 respectively. Find the loss of head due to contraction if $C_c = 0.62$. And also determine the rate of flow of water.

(c) Derive the Chezy's formula for loss of head due to friction in pipe. **(5+8+7 = 20)**

7. (a) Explain the Thoma's cavitation factors for centrifugal pumps? Write down the effects of cavitation for centrifugal pump.

(b) A pelton wheel is to be designed for the following specifications:

Shaft power = 11,772 KW; Head= 380 meter; speed= 750 rpm; overall efficiency= 86%; jet diameter is not to be exceed one-sixth of the wheel diameter. Determine:

(i) The wheel diameter,

(ii) The number of jet required,

(iii) Diameter of the jet.

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