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Fluid Mechanics
(1110, 1100, 1090)

P. Pages : 3

Time : Three Hours **Max. Marks : 100**

Instructions to Candidates :
1. Do not write anything on question paper except Seat No.
2. Answer sheet should be written with blue ink only. Graph or diagram should be drawn with the same pen being used for writing paper or black HB pencil.
3. Students should note, no supplement will be provided.
4. All questions are compulsory. Solve **any two** bits from each question.
5. Use of non - programmable calculator is allowed.
6. Figures to the right indicate full marks.
7. Assume suitable data if necessary.

1. a) A 15cm diameter vertical cylinder rotates concentrically inside another cylinder of diameter 15.10 cm. Both cylinders are 25 cm high. The space between the cylinders is filled with liquid whose viscosity is unknown. If a torque of 12.0 Nm is required to rotate the inner cylinder at 100 rpm. determine the viscosity of the fluid. **10**

b) A block of wood of specific gravity 0.7 floats in water. Determine the metacentric height of the block if its size is (2mx1mx0.8m). **10**

c) Prove that capillary rise in glass tube of small diameter of opened at both end is $h=\frac{46}{\rho gd}$ and also capillary fall $h=\frac{46\cos\theta}{\rho gd}$. **10**

2. a) Prove that Euler's Eq^{n} of motion is $\frac{\partial p}{\rho}+gdz+vdv=o$ and Bernoulli's Eq^{n} of motion. **10**

$$\frac{p}{\rho g}+\frac{v^2}{2g}+Z = \text{ Constant.}$$

b) The water is flowing through a taper pipe of length 100mm having diameters 600 mm at the upper end and 300 mm at the lower end at the rate of 50 liters /sec. The pipe has a slope of 1 in 30. Find the pressure at the lower end if the pressure at higher level is 19.62 N/cm^2. **10**

c) Prove that for venturi meter rate of flow. **10**

$$Q = Cd \frac{a_1 a_2}{\sqrt{a_1^2 - a_2^2}} \sqrt{2gh}$$

Where a_1 & a_2 are the area at inlet & throat.

3. a) A laminar flow is taking place in a pipe of diameter of 200mm. The maximum velocity is 1.5 m/s. Find the mean velocity and radius at which this occurs. Also calculate the velocity at 4cm from the wall of the pipe. **10**

b) What power is required per kilometer of a line to overcome the viscous resistance to the flow of glycerine through a horizontal pipe of diameter 100 mm at the rate of 10 lit / sec ? Take $\mu = 8 poise$ and Kinematic viscosity $\nu = 6.0 stokes$. **10**

c) What is Hagen poiseuille formula ? Derive an expression for Hagen Poiseulle's formula. **10**

4. a) A syphon of diameter 200mm connects two reservoir having difference in elevation of 15m. The total length of the syphon is 600m and the summit is 4m above the water level in the upper reservoir. If the separation takes place at 2.8 m of water absolute. Find the maximum length of syphon from upper reservoir to summit take 7=0.004 Atmospheric pressure = 10.3 m of water. **10**

b) For a Town water supply, a main pipe line of diameter 0.4 m is required. As pipes move than 0.35m diameter are not readily available, two parallel pipes of the same diameter were used for water supply. If the total discharge in the parallel pipes is same as in single main pipe. Find the diameter of the parallel pipe. Assume coefficient of friction same for all pipes. **10**

c) Prove that diameter of nozzle for maximum transmission of power through nozzle is. **10**

$$d = \left(\frac{D^5}{87L} \right)^{1/4} .$$

5. a) What is an Air vessel ? Describe with neat sketch working and function of the Air vessel for reciprocating pumps. **10**

b) Explain with the help of neat sketch, the principle and working of the hydraulic devices. **10**

i) Hydraulic coupling.

ii) Hydraulic Torque Converter.

c) Prove that for double acting reciprocating pump power required to drive the pump is. **10**

$$P = \frac{2\rho g\, ALN\, (hs + thd)}{60{,}000}$$

Where A = Cross sectional area of piston on cylinder.

L = Length of stroke.

hs - Height of the axis of the cylinder from water surface in sump.

hd - Height of the delivery outlet above the cylinder axis.

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