Prelim Paper **17421**
3 Hours / 100 Marks **Hydraulics**

Instructions : (1) All Questions are Compulsory.
(2) Answer each next main Question on a new page.
(3) Illustrate your answers with neat sketches wherever necessary.
(4) Figures to the right indicate full marks.
(5) Assume suitable data, if necessary.
(6) Use of Non-programmable Electronic Pocket Calculator is permissible.

1. Attempt any TEN of the following : **[20]**

(a) Define weight density and state its S.I. unit.
(b) Why mercury is used in manometer?
(c) What is the principle of manometer?
(d) Express a pressure intensity of 5 kg (f)/cm^2 in metres of head of water and mercury.
(e) What is venna-contracta?
(f) State four application of Hydraulics in environmental engineering.
(g) Define ideal fluid and real fluid.
(h) State Newton's law of viscosity.
(i) Mention necessity of inverted manometer.
(j) Define Froude's number.
(k) State 'Pascal's Law' of liquid pressure.
(l) Define Reynold's number.
(m) Define 'Hydraulic Meandepth' and its units.
(n) What is the difference between a 'notch' and a 'weir' ?

2. Attempt any FOUR of the following : **[16]**

(a) A simple U tube manometer is used to measure water pressure in pipe. The left limb of manometer is connected to pipe and right limb is open to atmosphere. The mercury level in left limb is 80 mm below centre of pipe and in right limb 40 mm above the centre of pipe. Calculate water pressure in pipe.
(b) A partition wall 3 m long divides storage tank. On one side there is turpentine of Sp. Gr. 0.87 upto a depth of 3.5 m. On the other side there is paraffin oil of Sp. Gr. 0.8 stored to a depth of 2.5 m. Determine resultant pressure on partition wall.
(c) State Bernoulli's theorem. State any two applications of it.
(d) A circular plate 1.5 m diameter is placed vertically in water so that the centre plate is 2.5 m below the free surface. Determine the total pressure on the plate and depth of centre of pressure.
(e) A rectangular plane surface is 2 m wide and 3 m deep. It lies in vertical plane in water. Determine the total pressure and position of centre of pressure on the plane surface when its upper edge is horizontal and 2.5 m below the free water surface.
(f) Explain briefly the working principle of Bourdon pressure gauge with a neat sketch.

3. Attempt any FOUR of the following : [16]

(a) Two horizontal plates are placed 12.5 mm apart. The space between them being filled with oil of viscosity 14 poise. Calculate shear stress in oil if upper plate moves with velocity 2.5 m/sec.

(b) Differentiate between Laminar flow and turbulent flow.

(c) What are stream lines an equipotential lines. State any two uses of flow net?

(d) Explain syphon pipe with sketch.

(e) Find the loss of head when a pipe of diameter 200 mm is suddenly enlarged to a diameter of 400 mm. The rate of flow of water through the pipe is 250 lit/sec.

(f) Explain HGL and TEL with sketch.

4. Attempt any FOUR of the following : [16]

(a) Define friction factor and state any four factors affecting friction factor.

(b) Water is flowing through a rectangular channel of width 8 m and bed slope 1 in 1000. Depth of flowing channel is 5 m. Find the discharge through channel. Take C = 50.

(c) The daily record of rainfall over a catchment is 0.2 million cubic meter. Out of this 80% rain water reaches the storage reservoir and passes over a rectangular weir. What should be its length if water level do not rise more than 400 mm above the crest. Take $C_d = 0.61$.

(d) A tank has two identical orifices in one of its vertical sides. The upper orifice is 2 m below the water surface and lower orifice is 4 m below the water surface. Find the point at which two jets will intersect, if the coefficient of velocity is 0.92 for both orifices.

(e) A rectangular channel 2.0 m wide has a discharge of 250 lit/sec., which is measured by a right-angled 'V' – notch weir. Find the position of the apex of the notch from the bed of channel if maximum depth of water is not to exceed 1.3 m. Take $c_d = 0.62$.

(f) With a neat sketch, explain the principle and working of a centrifugal pump.

5. Attempt any FOUR of the following : [16]

(a) Explain the phenomenon of water hammer.

(b) Differentiate between centrifugal pump and reciprocating pump. (Any four points)

(c) A centrifugal pump delivers water at 30 lit/sec to a height of 18 m thro' a pipe 90 m long and 100 mm in diameter. If overall efficiency of pump is 75% find power required to drive the pump. Take f = 0.012.

(d) Explain working principle of current meter with sketch. State types of it.

(e) A reservoir has a catchment area of 30 km^2. The maximum rainfall over the area is 2.5 cm/hour, 45% of which flows to the reservoir over a weir. Find length of the weir. The head over weir is 80 cm.

(f) A siphon of diameter 20 cm connects two reservoirs having a difference in elevation of 20 m. The length of the siphon is 500 m, and the summit is 3.0 m above the water level in the upper reservoir. The length of the pipe from upper reservoir to the summit is 100 m. Determine the discharge through the siphon and also pressure at summit. Neglect minor losses. Take coefficient of friction, f = 0.005.

6. Attempt any FOUR of the following : [16]

(a) Draw a neat sketch of Reciprocating pump showing its various component parts. Mention function of each component.

(b) A trapezoidal most economical channel section has side slopes 1.5 (H) : 1(V). It is required to discharge $20m^3$/sec with a bed slope of 1 m in 6.0 km. Design the section using Manning's formula. Take N = 0.015

(c) What do you mean by most economical section of an open channel?

(d) Define Prismatic and Non Prismatic channel and critical flow and subcritical flow.

(e) State any four practical applications of hydrostatics.

(f) Explain the following with neat sketches :

(i) Simple manometer and its types.

(ii) Differential monometers and its types.

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