This question paper contains 4 printed pages.

3315 *Your Roll No.* .....

B.Tech. (C) / II **J**

PAPER IV— HYDRAULIC ENGINEERING

(ECE-204)

Time : 3 hours *Maximum Marks* : 70

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt five questions.
Assume missing data suitably, if any.

1. (*a*) Explain the concept of hydrostatic paradox. 3

   (*b*) What are the hydraulic gradient and energy gradient lines? 3

   (*c*) A pipeline carrying oil of specific gravity 0·87 changes in diameter from 200 mm at a position A to 500 mm at another position B which is 4 meters at a higher level. If the pressures at A and B are 1 bar and 0·6 bar respectively and the discharge is 0·2 m^3/s, determine the loss of head and the direction of flow. 8

2. (*a*) Differentiate between the Eulerian and Lagrangian methods of representing fluid motion. 3

   (*b*) What do you understand by the best (economical)

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channel cross section? In how many ways can you express it? 3

(*c*) State the conditions for the formation of hydraulic jump in an open channel flow. A 4 m wide rectangular channel has the Froude's number before the hydraulic jump equal to 2·2. If the height of jump is 2·0 m, find the depth of flow before and after the jump. Find also the loss of energy due to the jump. 8

3. (*a*) State Bernoulli's theorem for the steady flow of an incompressible fluid. Derive an expression for Bernoulli's theorem from first principle and state the assumptions made for such a derivation. 3

(*b*) Show that at a critical state of flow, the specific energy in a rectangular channel is equal to 1·5 times the depth of flow and explain the difference between alternate depth and sequent depth of flow in open channels. 3

(*c*) A crude oil of viscosity 0·97 poise and relative density of 0·9 is flowing through a horizontal circular pipe of diameter 100 mm and length 10 m. Calculate the difference of pressure at the two ends of pipe; if 100 kg of oil is collected in a tank in 30 seconds. 8

4. (*a*) Explain the development of boundary layer along a thin plate parallel to uniform flow and define the different types of boundary layer thickness. 3

(*b*) What do you understand by water hammer? What provision is made in hydro-power plant to minimise the effects of water hammer? 3

(*c*) Three pipes of lengths 800 m, 500 m, and 400 m and of diameters 500 mm, 400 mm and 300 mm respectively are connected in series. These pipes are to be replaced by a single pipe of length 1700 m. Find the diameter of single pipe. 8

5. (*a*) What do you mean by gross head, net head and efficiency of turbine? Explain the different types of the efficiency of a turbine. 3

(*b*) Explain the different types of flow in open channel. 3

(*c*) A turbine is to operate under a head of 25 m at 200 r.p.m. The discharge is 9 cumec. If the efficiency is 90%, determine:

(*i*) Specific speed of turbine

(*ii*) Power generated by turbine

(*iii*) Type of turbine. 8

6. (*a*) Explain the velocity potential and stream function in detail.

What is the difference between free and forced vortex? 3

(*b*) What are the uses of draft tube? Describe with neat sketches for the different types of draft tube. 3

(*c*) A Pelton wheel is to be designed for a head of 60 m when running at 200 r.p.m. The Pelton wheel develops 95·65 kW shaft power. The velocity of the buckets is equal to 0·45 times the velocity of jet. Take overall efficiency 0·85 and the coefficient of velocity as 0·98. 8

7. (*a*) What is Cipolletti weir? Prove that the discharge through Cipolletti weir is given by:—

$$Q = \frac{2}{3} C_d L \sqrt{2g}\, H^{3/2}$$

where L=length of weir, H=head of water over weir. 3

(*b*) Prove that the discharge through a triangular weir is given by:—

$$Q = \frac{8}{15} C_d \tan\frac{\theta}{2} \sqrt{2g}\, H^{5/2}$$

where H=Head of water over the weir, θ=angle of weir. 3

(*c*) The head of water over an orifice of diameter 100 mm is 10 m. The water coming out from orifice is collected in a circular tank of diameter 1·5 m. The rise of water level in this tank is 1·0 m in 25 seconds. Also the co-ordinate of a point on the jet, measured from vena-contracta are 4·30 m horizontal and 0·50 m vertical. Find the hydraulic coefficients C_d, C_v and C_e. 8

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