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Sr. No. 002504

December 2023

B.Tech. (CIVIL) V SEMESTER

Hydraulic Engineering (PCC-CED-304)

Time: 3 Hours Max. Marks: 75

Instructions:
1. *It is compulsory to answer all the questions (1.5 marks each) of Part -A in short.*
2. *Answer any four questions from Part -B in detail.*
3. *Different sub-parts of a question are to be attempted adjacent to each other.*
4. *Use of non-programmable scientific calculator is allowed.*

PART -A

Q1 (a) Define and explain the terms: i) Hydraulic gradient line and ii) Total energy line. (1.5)

(b) What do you mean by most economical section of an open channel? (1.5)

(c) What is a specific energy curve? (1.5)

(d) Define (a) steady and unsteady flow; (b) uniform and non-uniform flow in the case of channels? (1.5)

(e) Define alternate depths and sequent depth with respective equations. (1.5)

(f) State the conditions under which the rectangular section of an open channel will be most economical. (1.5)

(g) Define GVF and RVF. (1.5)

(h) Write equation of energy loss in hydraulic jump. (1.5)

(i) What is positive and negative surge? (1.5)

(j) What are various types of reaction turbines? (1.5)

PART -B

Q2 (a) Show that for a trapezoidal channel of given area of flow, the condition of maximum flow requires that hydraulic mean depth is equal to one half the depth of flow. (10)

(b) A trapezoidal channel having bottom width 5 m and side slopes 1:1 carries a discharge of 12 m^3/s. Compute the critical depth and the critical velocity. If Manning's n = 0.02 determine the bottom slope required to maintain the critical depth. (5)

Q3 (a) Define various channel profiles and draw the flow profiles of M2, S3, A2 and C1 slopes with example and flow depth conditions. (5)

(b) Derive the equation of gradually varied flow. (10)

Q4 Define hydraulic jump. What are the various types of hydraulic jumps based on Fraude's Number? Derive the equation of sequent depth. (15)

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Q5 (a) Classify turbine based on 5 different categories. Also sketch the diagram of either Pelton wheel Turbine or Francis Turbine. (5)

(b) A Pelton wheel has a mean bucket speed of 12 m/s and is supplied with water at a rate of 750 liters per second under a head of 35 m. If the bucket deflects the jet through an angle of 160°, find the power developed by the turbine and its hydraulic efficiency. Take the coefficient of velocity as 0.98. Neglect friction in the bucket. Also determine the overall efficiency of the turbine if its mechanical efficiency is 80%. (10)

Q6 (a) A trapezoidal channel having bottom width 6 m, side slope 2 horizontal to 1 vertical, Manning's roughness coefficient 0.025, and bottom slope 0.0016, carries a discharge of 10 m^3/s. Compute the back water profile created by a dam which backs up the water to a depth of 2.0 m immediately behind the dam. Use the direct step method for computation. (10)

(b) The depth and velocity of flow in a rectangular channel are 1 m and 1.5 m/s respectively. If the rate of inflow at the upstream end is suddenly doubled, what will be the height and absolute velocity of the resulting surge and the celerity of the wave? (5)

Q7 Explain briefly the principles on which a Kaplan turbine works. (15)
A Kaplan turbine runner develops 9 300 kW under a net head of 7.4 m. Mechanical efficiency of the wheel is 86%, speed ratio based on outer diameter is 2.2 and the flow ratio is 0.66. Diameter of the boss is 0.35 times the external diameter of the wheel. Determine (i) diameter of the runner; (ii) its synchronous speed; (iii) the specific speed of the runner. Assume mechanical efficiency equal to overall efficiency.

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