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Question Paper Code : 40303

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2021.

Fourth Semester

Civil Engineering

CE 8403 – APPLIED HYDRAULIC ENGINEERING

(Regulations 2017)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define critical flow in open channel.

2. Differentiate between normal depth and critical depth in open channel.

3. State the condition for economical trapezoidal section.

4. Differentiate between flow through pipes and flow through an open channel.

5. Illustrate the positive surge in an unsteady open channel flow.

6. Define the backwater curve in a gradually varied flow profile and give a practical example for getting this type of profile.

7. Brief about NPSH in centrifugal pump.

8. Illustrate the reason for the occurrence of a negative slip in a reciprocating pump.

9. Identify why we cannot obtain 100% hydraulic efficiency in the Pelton wheel turbine.

10. Differentiate between impulse and reaction turbines.

PART B — (5 × 13 = 65 marks)

11. (a) (i) A channel of rectangular section 6m wide and 1.25m deep has a bed slope of 1 m 1200. It is provided with a lining for which Manning's N=0.018. Find the discharge in the channel. If it is desired to increase the discharge to the maximum extent for the same bed slope and for the same amount of lining, find the new dimensions of the rectangular section. Find also the percent increase in the discharge. (8)

(ii) What is specific energy and what is the situation for getting alternate depths equal? (5)

Or

(b) A trapezoidal section has side slopes of 1 vertical to 1 horizontal and has to convey a discharge of 14 m^3/s. The bed slope of the channel is 1 in 1000. Chezy's constant is 45 if the channel is unlined and is 70 if the channel is lined with concrete. The cost per cubic meter of excavation is 3 times the cost per square of the lining. Find the cost per meter length of providing the channel and state which arrangement is economical. Take cost per square meter of lining = x. (13)

12. (a) Derive the dynamic equation of a gradually varied flow and state the assumptions made to derive the equation. (13)

Or

(b) A channel of rectangular section 12m wide conveys water at a normal depth of 1.8 m, the bed slope being 1 in 1800. Due to an obstruction in the form of an overflow dam the water level near the obstruction rises by 1m. Find the slope of the water surface near the obstruction with respect to the horizontal. Take $N = 0.025$. (13)

13. (a) In a hydraulic jump taking place in a horizontal rectangular channel, the Froude number before the jump is 10 and energy loss during the jump is 4m. Find (a) depths before and after the jump, (b) the intesity of discharge and (c) Froude number after the jump. (13)

Or

(b) A river of rectangular section, 15 m wide has a bed slope of 1 in 12100 The normal depth of water is 2 m. A weir constructed in the river raises the water level 3m just on its upstream side. Find the type of profile (curve) formed and length of the profile if n = 0.025 using the direct step method. (Take only one step). (13)

14. (a) The centrifugal pump with the following data is designed to run at 1500rpm. Inner dia D_1=10cm, outer dia D_2=30cm, width at inlet B_1=5cm, width at outlet B_2=2cm, velocity of flow at inlet V_{f1}=3m/s and outlet blade angle is 60°. Find the following (a) volume of flow rate and velocity of flow at the outlet; (b) inlet blade angle, (c) K.E. with outgoing water and (d) power of the pump. (13)

Or

(b) With a neat sketch derive the basic equation of effect of acceleration in suction and delivery pipes of the reciprocating pump with an indicator diagram. (13)

15. (a) (i) Explain the working of the axial flow reaction turbine with a neat sketch. (8)

(ii) What is a draft tube in reaction turbine? And explain its types with neat sketch. (5)

Or

(b) A francis turbine is designed to develop 150 kW when working under a head of 8 m and running at 150 rpm. The hydraulic loss in the turbine is 20% of available energy and overall efficiency is 80%. Take speed ratio=0.25 and flow ratio=0.95. Find (a) the guide blade angle and wheel vane angle at the inlet and (b) diameter and width of the wheel at the inlet. (13)

PART C — (1 × 15 = 15 marks)

16. (a) Design a Pelton wheel with the following data; net head=800m, speed=600rpm. coefficient of velocity for the jets=0.97, speed ratio=0.46 the diameter of the jet is not to exceed one-sixteenth the wheel diameter, overall efficiency=85% and power developed=13250 kW. (15)

Or

(b) A trapezoidal channel having bottom width 6m, side slope 2 horizontal to 1 vertical, Manning's roughness coefficient 0.025 and bottom slope 0.0016 carries a discharge of $10m^3$/sec. Computer the backwater profile created by a dam which backs up the water to a depth of 2.0m immediately behind the dam. Use the direct step method for computation. (15)

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