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Question Paper Code : 20327

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2022.

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. What is the purpose of providing bed slope in open channels?
2. Define 'Most Economical Section' in open channel flow.
3. Obtain the relation between Manning's constant and Chezy's constant.
4. Write the methods used for flow profile determination
5. Draw specific energy curve. Mention its salient points.
6. Differentiate subcritical and super critical flow.
7. What are the functions of a draft tube?
8. Compare impulse and reaction turbines.
9. Define volumetric efficiency of pump.
10. Draw an indicator diagram, considering the effect of acceleration and friction in suction and delivery pipes.

PART B — (5 × 13 = 65 marks)

11. (a) (i) Differentiate pipe flow and open channel flow. (8)

(ii) A concrete lined circular channel of 3.6 m diameter has a bed slope of 1 in 600. Determine the velocity and flow rate for the conditions of : (1) Maximum velocity and (2) Discharge. Take Chezy's constant, C = 50. (5)

Or

(b) (i) Show that the condition for the rectangular channel of best section. (8)

(ii) A canal of trapezoidal section has bed width of 8 m and bed slope of 1 in 4000. If the depth of flow is 2.4 m and side slopes of the channel are 1 horizontal to 3 vertical, determine the average flow velocity and the discharge carried by the channel. Take value of Chezy's constant = 55. (5)

12. (a) Find the length of the backwater curve caused by an afflux of 2.0 m, in a rectangular channel of width 40 m and depth 2.5 m. The slope of the bed is given as 1 in 11000. Take Manning's N = 0.03.

Or

(b) Classify and characterize the various water surface profiles obtained in a steady gradually varied flow in a prismatic channel under different slopes.

13. (a) (i) Derive the expression of critical depth and critical velocity. (5)

(ii) Calculate the specific energy of 12 m^3/s of water flowing with a velocity of 1.5 m/s in a rectangular channel 7.5 m wide. Find the depth of water in the channel when the specific energy would be minimum. What would be the value of critical velocity as well as minimum specific energy? (8)

Or

(b) (i) Derive the expression for loss of energy head for a hydraulic jump. (8)

(ii) A hydraulic jump occurs in a rectangular channel and the depths of flow before and after the jump are 0.5 m and 2 m respectively. Calculate the critical depth of flow. (5)

14. (a) (i) A jet of water of 75 mm diameter strikes a curved vane at its Centre with a velocity of 20 m/s. The curved vane is moving with a velocity of 8 m/s in the direction of jet. Find the force exerted on the plate in the direction of the jet, power and efficiency of the jet. Assume the plate to be smooth. (8)

(ii) Derive an expression for maximum hydraulic efficiency of a Pelton wheel. (5)

Or

(b) (i) A Kaplan turbine produces 44000 kW under a head of 24.7 m, with an overall efficiency of 90 per cent. Taking the value of speed ratio as 1.6, flow ratio as 0.5 and the hub diameter as 0.35 times the outside diameter, find the runner diameter and speed of the turbine. (8)

(ii) Enumerate some methods to avoid cavitation in water turbines. (5)

15. (a) (i) Draw and explain characteristic curves for a centrifugal pump. (8)

(ii) Derive an expression for the minimum speed for starting a centrifugal pump. (5)

Or

(b) (i) A single-acting reciprocating pump, running at 60 r.p.m., delivers 0.53 m^3 of water per minute. The diameter of the piston is 200 mm and stroke length 300 mm. The suction and delivery heads are 4 m and 12 m respectively. Determine : (8)

(1) Theoretical discharge,

(2) Co-efficient of discharge,

(3) Percentage slip of the pump, and

(4) Power required to run the pump.

(ii) Explain with neat sketches the function of air vessels in a reciprocating pump. (5)

PART C — (1 × 15 = 15 marks)

16. (a) Design an earthen trapezoidal channel for water having a velocity of 0.6 m/s. Side slope of the channel is 1:1.5 and quantity of water flowing is 3 m^3/s. Assume C in Chezy's formula as 65.

Or

(b) Francis turbine has to be designed to develop 367.5 kW under a head of H = 70 m while running at N = 750 r.p.m. Ratio of width of runner to diameter of runner, n = 0.1, inner diameter is half the outer diameter. Flow ratio = 0.15, hydraulic efficiency = 95%, mechanical efficiency = 84%. Four percent of the circumferential area of runner to be occupied by the thickness of vanes, velocity of flow is constant and the discharge is radial at exit. Calculate : (i) the diameter of the wheel, (ii) the quantity of water supplied, and (iii) the guide vane angle at inlet and runner vane angles at inlet and exit.