

Page 1

- PART A — (10 × 2 = 20 marks)

PART B — (5 × 16 = 80 marks)

11. (a) A 8 m wide channel conveys 15 cumecs of water at a depth of 1.2 m. Determine
- (i) Specific energy of the flowing water
 - (ii) Critical depth
 - (iii) Critical velocity
 - (iv) Minimum specific energy
 - (v) Froude number and also state whether the flow is sub critical or super critical. (16)

Or

- (b) A trapezoidal channel with side slopes of 3H : 2V has to be designed to convey 10 m³/s at a velocity of 1.5 m/s, so that the amount of concrete lining for the bed and the sides is the minimum. Find
- (i) the wetted perimeter and
 - (ii) slope of the bed if Manning's $N = 0.014$ in the formula $C = (1/N)(m^{1/6})$. (16)
12. (a) Derive the dynamic equation for gradually varied flow stating the assumptions made. (16)

Or

- (b) A trapezoidal channel with bed width of 10 m and side slopes IV : 1.5 H is carrying a flow of 80 m³/s. The channel bottom slope is 0.002 and Manning's 'n' is 0.015. A dam is planned in such a way that the flow depth increases to 10 m. Determine the depth of flow in the channel 250 m, 500 m and 750 m upstream of the dam. Use Standard step method. (16)
13. (a) The Froude number before the jump is 10.0 in a hydraulic jump occurring in a rectangular channel and the energy loss is 3.20 m. Estimate the
- (i) Sequent depth
 - (ii) The discharge per unit width. (16)

Or

- (b) A rectangular channel carries a flow with a velocity of 0.65 m/s and depth of flow 1.4 m. The discharge is abruptly increased three fold by a sudden lifting a gate on the upstream. Estimate the velocity and the height of resulting surge. (16)

14. (a) The following data refer to an inward flow reaction turbine :

External and internal diameters = 1.2 m and 0.6 m.

Head = 22 m, Guide blade angle = 10° .

Velocity of flow is constant and equal to 2.5 m/s. The vanes are radial at inlet. Assume the discharge at outlet also radial. Calculate the following :

- (i) Speed of turbine
- (ii) Vane angle at outlet and
- (iii) Hydraulic efficiency. (16)

Or

- (b) The penstock supplies water from a reservoir to the Pelton wheel with a gross head of 500 m. One third of the gross head is lost in friction in the penstock. The rate of flow of water through the nozzle fitted at the end of the penstock is $2.0 \text{ m}^3/\text{s}$. The angle of deflection of the jet is 165° . Determine the power given by the water to the runner and also hydraulic efficiency of the Pelton wheel. Take speed ratio as 0.45 and C_v as 1.0. (16)

15. (a) A centrifugal pump having outer diameter equal to two times the inner diameter and running at 1000 r.p.m. works against a total head of 40 m. The velocity of flow through the impeller is constant and equal to 2.5 m/s. The vanes are set back at an angle of 40° at outlet. If the outer diameter of the impeller is 500 mm and width at outlet is 50 mm determine :

- (i) Vane angle at inlet
- (ii) Work done by impeller on water per second and
- (iii) Manometric efficiency. (16)

Or

- (b) The cylinder bore diameter of a single acting reciprocating pump is 150 mm and its stroke is 300 mm. The pump runs at 50 r.p.m. and lifts water through a height of 25 m. The delivery pipe is 22 m long and 100mm in diameter. Find the theoretical discharge. If the actual discharge is 4.2 litres/s, find the percentage slip. Also determine the acceleration head at the beginning and middle of the delivery stroke. (16)

