



(b) (i) Derive the relationship between flow depth and breadth of a rectangular channel, to be an economical section. (8)

(ii) A rectangular channel which is laid on a bottom slope of 1 in 160 is to carry  $20 \text{ m}^3/\text{s}$  of water. Determine the width of the channel when the flow is in critical condition. Take Manning's constant  $n=0.014$ . (8)

12. (a) Discuss the different surface profiles for the various bottom slope conditions of a channels.

Or

(b) A rectangular flume 2m wide discharge at the rate of  $2 \text{ m}^2/\text{s}$ . The bed slope of the flume is 1 in 2500. At a certain section the depth of flow is 1 m. Calculate the distance of the section downstream where the depth of flow is 0.9 m. Solve by single step method. Assume  $n=0.014$ .

13. (a) Water flows from an under sluice into a very wide rectangular channel. The channel has a bed slope of 1 in 1000. The sluice is regulated to discharge  $6 \text{ m}^3/\text{s}$  per m width of channel, the depth of venacontracta being 0.5 m. Will a hydraulic jump form? If so determine its location. Use a single step for the computation with Manning's constant  $n=0.015$ .

Or

(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?

14. (a) A kaplan turbine is to be designed to develop 9000 kW. The net available head is 5.6 m. The speed ratio is 2.09 and the flow ratio is 0.68. The overall efficiency is 86% and the diameter of the boss is one-third the diameter of the runner. Determine the diameter of the runner, speed and specific speed of the turbine.

Or

(b) A pelton wheel is to be designed for the following specifications : Shaft power = 11,772 kW, Head = 380 m; speed = 750 rpm; overall efficiency = 80%; Jet diameter is not to exceed  $1/6$  of the wheel diameter. Determine the following :

- (i) Wheel diameter
- (ii) Number of jets required
- (iii) Diameter of jet.

Assume  $K_v=0.985$  and  $K_u=0.45$ .

15. (a) A centrifugal pump has the following characteristics :

Outer diameter of impeller = 800 mm

Width of impeller vanes at outlet = 100 mm

Angle of impeller vanes at outlet =  $40^\circ$ .

The impeller runs at 550 rpm and delivers  $0.98 \text{ m}^3/\text{s}$  under an effective head of 35 m. A 500 kW motor is used to drive the pump. Determine the monometric, mechanical and overall efficiencies of the pump. Assume water enters the impeller vanes radially at inlet.

Or

- (b) A double-acting reciprocating pump, running at 40 rpm, is discharging  $1 \text{ m}^3/\text{s}$  water. The pump has a stroke length of 400 mm. The diameter of the piston is 200 mm. The delivery and suction head are 20 m and 5 m respectively. Find the slip of the pump and power required to drive the pump.