

(b) (i) What is air vessel? What shortcomings of the pump are made up by providing air vessels? (5)

(ii) A single acting reciprocating pump has a plunger of diameter 150 mm and a stroke 300 mm. The lengths of the suction and delivery pipes are 5 m and 20 m respectively, and their diameter is 75 mm. The suction and delivery heads are 3.5 m and 8 m respectively. Find the pressure head in the cylinder at the beginning, middle and end of the suction and delivery strokes. Take coefficient of friction $f = 0.0075$ and speed of the pump = 30 rpm. Find also the power required to drive the pump. Take atmospheric pressure head = 10.3 m of water. (8)

PART C — (1 × 15 = 15 marks)

16. (a) A wide channel laid to a slope of 1 in 1000 carries a discharge of $3.5 \text{ m}^3/\text{s}$ per meter width at a depth of 1.6 m. Find out the value of Chezy's constant. Consider the flow is uniform. If the actual depth varies from 1.5 m at an upstream location to 1.7 m at the location 300 m downstream. What will be the value of Chezy's constant? (15)

Or

(b) The Figure 2 below shows a smooth curved vane attached to a rigid foundation. The jet of water, rectangular in section, 75 mm wide and 25 mm thick, strike the vane with a velocity of 25 m/s. Calculate the vertical and horizontal components of the force exerted on the vane and indicate in which direction these components act. (15)

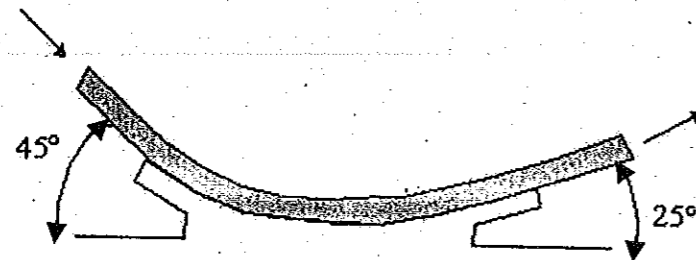


Fig. 2

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B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2019.

Fourth Semester

Civil Engineering

CE 8403 — APPLIED HYDRAULIC ENGINEERING

(Regulation 2017)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define total Energy line.
2. What are the properties of open channels?
3. What is control section in Gradually varied flow?
4. Where the break in grades is used?
5. Classify the hydraulic jump.
6. Define Wave celerity.
7. Define Impulse Momentum Principle.
8. What is cavitation of the turbine?
9. What do you mean by NPSH?
10. Define slip and negative slip of the reciprocating pump.

PART B — (5 × 13 = 65 marks)

11. (a) (i) Differentiate between pipe flow and open channel flow (5)
- (ii) A circular pipe of diameter 1 m has to carry a maximum discharge of $0.8 \text{ m}^3/\text{s}$. Calculate the required slope. Use Manning's formula $n = 0.0167$. (8)

Or

- (b) (i) A rectangular channel has a width of 2.5 m and a slope of 1 in 400. Find the normal depth of flow if the discharge is 10 cumecs. Use Chezy's formula, $C = 50$. (5)
- (ii) Derive the most economical side slopes of trapezoidal section. (8)
12. (a) (i) Derive the dynamic equation of Gradually varied flow. (5)
- (ii) A river 90 m wide and 3 m deep has stable bed and vertical banks with a bed slope of 1 in 2500. Estimate the length of back water curve produced by an afflux of 2 m. Assume Manning's $n = 0.035$. (8)

Or

- (b) (i) A long rectangular channel of width 4 m has a slope of 1:5000 and a Manning's n of 0.015. The total discharge is $8 \text{ m}^3/\text{s}$. The channel narrows to a width of 1 m.
- (1) Determine the normal depth for the 4 m wide channel.
- (2) Show that critical conditions occur at the narrow 1 m wide section. (8)
- (ii) Describe with neat sketch the classification of channel profile. (5)
13. (a) (i) Derive the application of momentum equation for Rapidly varied flow. (8)
- (ii) A sluice gate at the base of a large reservoir is raised 1.7 m, as shown in Fig. 1, and the water discharges through this 5.0 m-wide rectangular orifice into a rectangular channel of the same width. If a hydraulic jump forms in the channel, what will be its height? (5)

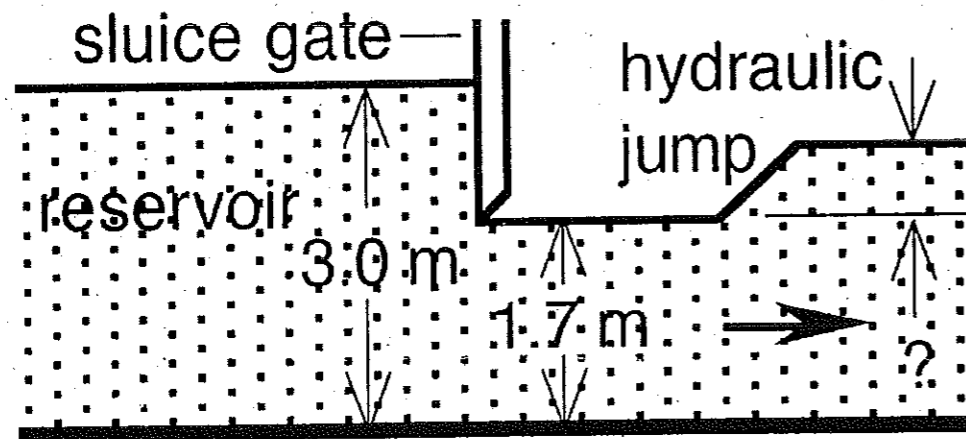


Fig. 1

Or

- (b) (i) Derive the expression for the energy loss during a hydraulic jump also writes down the assumption made. (8)
- (ii) The tidal bore is observed to travel at a velocity 10 m/s. The initial uniform flow depth is 3 m at a velocity of 2 m/s. Estimate the height, final velocity and discharge. (5)

14. (a) (i) The internal and external diameters of an inward flow reaction turbine are 0.8 m and 1.2 m respectively. The width of the wheel at inlet and outlet is 150 mm. the head on the turbine is 10 m and hydraulic efficiency is 92%. The vane angle at outlet is 20° .

Final discharge at outlet is radial at a velocity of 3 m/s. find

- (1) The guide blade angle
- (2) The runner vane angle at inlet
- (3) The speed of the turbine
- (4) The discharge of the turbine
- (5) The runner power. (8)

- (ii) What are the main components of Kaplan turbine? Explain with a neat sketch. (5)

Or

- (b) (i) Explain the important types of characteristics curves of the turbine. (8)

- (ii) A jet of water having a velocity of 40 m/s impinges without shock on a series of vanes moving at 12 m/s. the jet is making an angle of 20° with the direction of motion of the vane. Relative velocity at exit is 0.9 times the relative velocity at entrance and the absolute velocity of water at exit is normal to the direction of the motion of the vanes. Find, the vane angles at entrance and exit, work done on the vanes per unit weight of water supplied by the jet and hydraulic efficiency. (5)

15. (a) (i) What is minimum starting speed of a centrifugal pump? Obtain an expression for the minimum starting speed of a centrifugal pump. (5)

- (ii) The impeller of a centrifugal pump is 0.5 m in diameter and rotates at 1200 rpm. Blades are curved back to an angle of 30° to the tangent at outlet tip. If the measured velocity of flow at outlet is 5 m/s, find the work input per kg of water per second. Find the theoretical maximum lift to which the water can be raised if the pump is provided with whirlpool chamber which reduces the velocity of water by 50%. (8)

Or