



CBCS SCHEME

17CV43

Fourth Semester B.E. Degree Examination, Jan./Feb. 2021 Applied Hydraulics

Time: 3 hrs.

Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

- Define dimensional homogeneity. Give two examples. (04 Marks)
 - Explain how repeating variables are selected for dimensional analysis in π -theorem. Also state π -theorem. (06 Marks)
 - The frictional torque T of a disc of diameter D rotating at a speed N in a fluid of viscosity μ and density ρ in a turbulent flow is given by

$$T = D^5 N^2 \rho \phi \left(\frac{\mu}{D^2 N \rho} \right).$$

Prove this by Buckingham's π - theorem.

(10 Marks)

OR

- Define (i) Metacentric height (ii) Buoyancy (iii) Prototype (iv) Similitude. (08 Marks)
 - What do you understand by Froude model law? Mention its applications. Derive any 5 scale ratios for physical quantities based on Froude model law. (12 Marks)

Module-2

- Derive Chezy's equation for flow through an open channel. Bring out relation between N and C . (10 Marks)
 - A trapezoidal channel has to carry $142 \text{ m}^3/\text{minute}$ of water is designed to have a minimum cross section. Find the bottom width and depth of the bed slope is 1 in 1200, the side slopes at 45° and Chezy's coefficient is 55. (10 Marks)

OR

- What is specific energy? Define and draw specific energy curve and also derive expressions for critical depth and critical velocity. (10 Marks)
 - The discharge of water through a rectangular channel of width 6m is $18 \text{ m}^3/\text{sec}$ when depth of flow of water is 2m. Calculate
 - Specific energy of the flowing water
 - Critical depth and critical velocity
 - Value of minimum specific energy
 - State whether the flow is subcritical or supercritical. (10 Marks)

Module-3

- Explain the term hydraulic jump with a neat sketch. Derive an expression for loss of energy due to hydraulic jump. (10 Marks)
 - A sluice gate discharges water into a horizontal rectangular channel with a velocity of 6 m/s and depth of flow is 0.4m. The width of the channel is 8m. Determine whether a hydraulic jump will occur and if so, find its height and loss of energy per kg of water. Also find power lost in the hydraulic jump. (10 Marks)

OR

- 6 a. With a neat sketch, explain what is back water curve and afflux. Derive an expression for length of backwater curve. (10 Marks)
- b. Find the slope of the free water surface in a rectangular channel of width 15m having depth of flow 4m. Discharge through channel is $40 \text{ m}^3/\text{sec}$. Bed of channel is having a slope of 1 in 4000. Take Chezy's $C = 50$. (10 Marks)

Module-4

- 7 a. With a neat sketch explain the concept of velocity triangles. (10 Marks)
- b. A jet of water having a velocity of 35 m/s impinges on a series of vanes moving with a velocity of 20 m/s. The jet makes an angle of 30° to direction of motion of vanes when entering and leaves at 12° .
- (i) Draw velocity Δ^{les} at inlet and outlet
- (ii) Find angles of vane tips so that water enters and leaves without shock.
- (iii) Work done per unit wt. of water entering the vanes. (10 Marks)

OR

- 8 a. Draw a typical layout of a hydroelectric plant and explain various heads. (10 Marks)
- b. A Pelton wheel is to be designed for following specifications:
Shaft power = 11,772 kW ; Head = 380 m ; Speed = 750 rpm ; Overall efficiency = 86%
Jet diameter not to exceed $1/6^{\text{th}}$ of wheel ϕ . Determine (i) Wheel diameter (ii) No. of Jets. (10 Marks)

Module-5

- 9 a. Define Draft Tube. Explain the draft tube theory with a sketch. (10 Marks)
- b. Draw Kaplan turbine and label the parts legibly. Give the working proportions. (10 Marks)

OR

- 10 a. With the help of a neat sketch, explain main parts of a centrifugal pump. (07 Marks)
- b. The diameter of an impeller of a centrifugal pump at inlet and outlet are 30cm and 60 cm respectively. The velocity of flow at outlet is 2.0 m/s and the vanes are set back at an angle of 45° at the outlet. Determine the minimum starting speed of the pump if manometer η is 70%. (08 Marks)
- c. Write a short note on multistage pumps. (05 Marks)

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