

M.E. (Water Resources & Hydraulic Engg.) Examination (6 Semester), 2025
(4th Semester)

RIVER HYDRAULICS & ENGINEERING

(Paper – IX)

Time : Three Hours

Full Marks : 100

Answer any *four* questions.

1. a) Differentiate between GVUF and RVUF with examples.
b) Derive the Saint Venant equations for unsteady flow
c) What do you mean by quasi-steady wave?
b) State and derive the Kleitz-Seddon Law for river flood waves.

5+15+2+3 = 25

2. a) Prove that the maximum uniform absolute velocity of the wave V_w is 5/3 times of normal velocity for a wide rectangular channel.
b) Define the monoclinal wave/rising limb of a flood wave.
c) Prove that the actual discharge (Q) is larger than the discharge read by the normal stage-discharge relationship (Q_n) during the rising stages in a flood flow in a river.
d) Derive the characteristic equations using MOC for a unit width, wide rectangular channel having gradually varied unsteady flow without lateral inflow. Also, explain the characteristics-grid method.

5+2+6+12= 25

3. a) What do you understand by positive surge and negative surge in a rapidly varied unsteady flow? Explain with neat sketches.
b) What do you mean by flood wave diffusivity?
c) Prove the following relation for river flood waves:

$$S_f = S_0 - \left[1 - (\beta - 1)^2 Fr^2 \right] \frac{\partial y}{\partial x}$$

- d) Water flows at a depth of 2.5 m and a velocity of 0.9 m/s in a rectangular channel into a large lake. The level of water in the lake is initially the same as that in the river but suddenly starts falling and the velocity at the junction with the lake starts increasing at the rate of 0.3 m/s per hour for a period of 6 hours. Determine how long it takes for the velocity in the river at a distance of 2 km upstream of the lake to increase to 1.9 m/s. How far upstream of the lake is the flow velocity affected at this moment? Assume $S_0 = S_f = 0$.

5+2+8+10 = 25

[Turn over

4. a) Consider a sluice gate in a horizontal frictionless channel suddenly raised to cause a quick change in the depth. Based on this condition, derive the following equation assuming proper notations:

$$\frac{(V_w - V_1)^2}{gy_1} = \frac{1}{2} \frac{y_2}{y_1} \left(\frac{y_2}{y_1} + 1 \right)$$

- b) A rectangular channel 40 m wide has a discharge of 36 cumec with a velocity of 0.80 m/s. If a sudden release of additional flow at the upstream end of the channel causes the depth to rise by 40%, determine the absolute velocity of the resulting surge and the new flow rate.
- c) Mention the relationship established by Lane (1957) and explain the difference between meandering channel and braided channel with appropriate figure?
- d) What is Cellular Concrete Mattresses Block revetment and what are the advantages and disadvantages of Cellular Concrete Mattresses Block revetment? Mention the common reasons for failure.

10+5+4+6=25

5. a) What is meant by meander change? Explain
- b) How rivers can be classified according to their sediment load?
- c) How rivers can be classified according to their channel configuration?
- d) What are the considerations that should be taken while designing a revetment?
- e) What is a Vane dyke. Explain with diagram
- f) What are the different conditions for Braiding.

4+2+6+5+4+4=25

6. a) What is the relation between Radius of curvature, depth of the channel and cost of constructing protection structures in rivers?
- b) What are the major types of rectification works carried out in rivers? Explain with figures.
- c) What are gabions? Write down the advantages and disadvantages of gabions? What are the common reasons for failure of gabions?
- d) Factors considered in developing a dredging operation?

5+5+10+5=25