M.E. (Water Resources & Hydraulic Engineering) Examination, 2024

(2nd Semester)

RIVER HYDRAULICS & ENGINEERING

(Paper – VIII)

Time : Three Hours | Full Marks : 100

Answer any ***four*** questions.

1. a) Heavy rainfall in a catchment which gives rise to floods in rivers is an example of

(i) GVF (ii) GVUF (iii) RVF (iv) RVUF (v) both (ii) and (iii)

b) The equation of motion of GVUF differs from the differential equation of GVF by one essential term. This term is

(i) $\frac{1}{g}\frac{\partial V}{\partial x}$ (ii) $\frac{\partial V}{\partial t}$ (iii) $\frac{1}{g}\frac{\partial V}{\partial t}$ (iv) $\frac{1}{g}\frac{\partial y}{\partial x}$ (v) $\frac{\partial y}{\partial x}$

c) What do you mean by tidal bore?

d) Derive Saint Venant equations in the following form:

$$A\frac{\partial V}{\partial x}+V\frac{\partial A}{\partial x}+T\frac{\partial y}{\partial t}=0$$

$$\frac{1}{Ag}\frac{\partial Q}{\partial t}+\frac{2Q}{A^2 g}\frac{\partial Q}{\partial x}+\left(1-F^2\right)\frac{\partial y}{\partial x}=S_0-S_f$$

Assume, that gradually varied unsteady flow in a river with negligible initial momentum in the longitudinal x- direction and momentum correction factors are unity. Use proper notations.

2+2+2+19= 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) State and derive the Kleitz-Seddon Law for river flood waves.

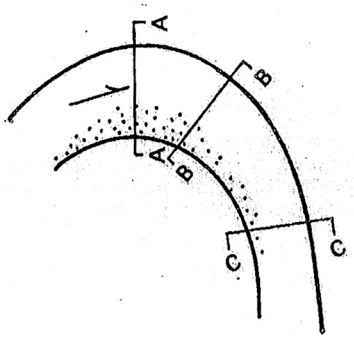
c) Prove the following relation for river flood waves:

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

d) Water flows at a depth of 2.5 m and a velocity of 1.0 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

4. a) The figure above shows a river reach and the arrow shows the flow of a river. Draw the shape of the cross section at sections A, B and C and explain.



b) What are gabions? Write down the advantages and disadvantages of gabions.

c) Derive the equation of wave velocity as function of the velocity before the passage of the surge and depth before the passage of the surge and depth after the passage of the surge.

d) In a tidal river the depth and velocity of flow are 0.85 m and 1.20 m/s respectively. Due to tidal action a tidal bore of height 1.15 m is observed to travel upstream. Estimate the height and speed of the bore and the speed of flow after the passage.

3+7+8+7 = 25

5. a) During a flood flow the depth of water in a 10m wide rectangular channel was found to be 3.0m and 2.9m at two sections 200m apart. The drop in the water-surface elevation was found to be 0.12m. Assuming Manning's coefficient to be 0.025, estimate the flood discharge through the channel.

b) What are the guidelines for selecting the number of segments in the case of the area-velocity method of stream flow measurement?

c) Explain in detail the moving boat method of stream flow measurement.

d) Describe in detail the stream flow measurement by the electromagnetic method.

e) Describe briefly the sudden injection or gulp dilution method of flow measurement.

10+3+4+4+4 = 25

6. a) What are the characteristics of meandering?

b) What is Fiber Mattress revetment and what are the advantages and disadvantages of Fiber Mattress revetment? Mention the common reasons for failure.

c) What are the major types of rectification works carried out in rivers?

d) What are the considerations that should be taken while designing a revetment? What are the different types of revetments?

e) What is Riprap revetment and what are the advantages of riprap revetment?

5+7+4+5+4 = 25