M.E. (Water Resources & Hydraulic Engineering) Examination, 2018

(2^{nd} Semester)

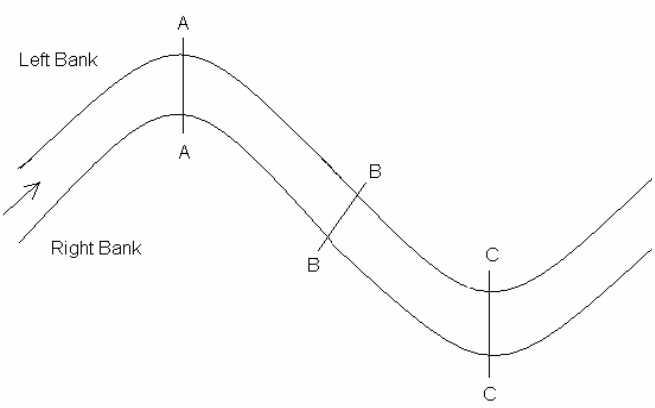
RIVER HYDRAULICS & ENGINEERING

(Paper – VIII)

Time : Three Hours Full Marks : 100

Answer any ***five*** questions.

1. a) What do you mean by physical characteristics of a river and what are the factors on which the physical characteristics of a river depend?
   b) How rivers can be classified based on channel configuration?
   c) What is meant by meander change? Explain.
   d) What are the steps of formation of a cut-offs?
   e) The figure beliw shows a river reach and the arrow shows the flow of river.



Draw the shape of the cross section at sections A, B and C and explain.

6+5+3+3+3 = 20

2. a) What are the major types of rectification works carried out in rivers? Explain with figures.
   b) What are the considerations that should be taken while designing a revetment? What are the different types of revetments?
   c) What is Fiber Mattress revetment and what are the advantages and disadvantages of Fiber Mattress revetment? Mention the common reasons for failure.
   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.

3+3+7+7 = 20

3. a) What are gabions? Write down the advantages and disadvantages of gabions?
   b) How dredged material can be used or recognized as a resource?
   c) Factors considered in developing a dredging operation?
   d) Mention five important uses of dredging.

6+4+5+5 = 20

4. a) Prove the following relation for river flood waves:

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

   b) An observer measures the flow depth in a 600 m wide rectangular river inclined at a bed slope of 0.0025 with Manning coefficient 0.02. Initially, the flow depth is 10m and the water level rises at a rate of 1 m/h. Calculate (i) the initial discharge at a distance of 1.2 km downstream, (ii) relative magnitude of the acceleration terms in the St. Venant equation and (iii) determine whether the flood wave attenuates as it propagates downstream.

10+10 = 20

5. a) Draw and explain the characteristic lines for subcritical and supercritical flow using MOC.
   b) 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 $S_0 = S_f = 0$.
   c) A rectangular channel 4.0 m wide carries a discharge of 12 m^3/s at a depth of 2.0 m. calculate the height and velocity of a surge produced when the flow is suddenly stopped completely by the full closure of a sluice gate at the downstream end.

4+9+7 = 20

6. a) 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.
   b) Find out the differential equation of a monoclonal rising wave in the following form:

$$\frac{\partial y}{\partial x} = \frac{S_0 - S_f}{1 - \frac{Q_r^2 T}{gA^3}}$$

where Q_r is termed as overrun.

12+8= 20

7. a) Explain the four point explicit finite-difference scheme to convert the St Venant equations into a set of algebraic equations in such a way that the unknown terms (V and y) at the end of a time step are expressed by known terms at the beginning of the time step.

   b) Assume a sluice gate in a horizontal frictionless channel suddenly raised to cause a positive surge travelling down the channel having unit width. Derive the following equation using proper notations:

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

   c) A rectangular channel carries a flow with a velocity of 0.65 m/s and depth of 1.40 m. If the discharge is abruptly increased threefold by a sudden lifting of a gate on the upstream, estimate the velocity and the height of the resulting surge.

6+7+7 = 20

8. a) Derive the following relationship between river velocity V_1, wave velocity V_w and depth before negative surge moving upstream section due to sudden release of control gate at a reservoir.

$$V_w = 3\sqrt{gy} - 2\sqrt{gy_1} - V_1$$

   b) Prove the following relationship considering a negative surge produced in a horizontal frictionless channel due to sudden raising of a sluice gate at a downstream section.

$$q_{x=0} = \frac{8}{27}\sqrt{gy_1^3}$$

   where $q_{x=0}$ is the discharge per unit width at the sluice gate and y_1 is the depth at the upstream of the channel having no wave effect.

   c) A sluice gate in a rectangular horizontal channel carrying a discharge of 10 m^3/s per meter width at a depth of 2.50 m partially closed to reduce the discharge by 60%. Calculate the height of the negative surge and the velocity of flow after the passage of the wave.

8+6+6 = 20