M.E. (Water Resources & Hydraulic Engg.) Examination (6 Semester), 2018

(4^{th} Semester)

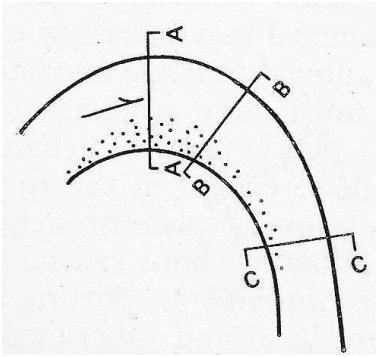
RIVER HYDRAULICS & ENGINEERING

(Paper – IX)

Time : Three Hours Full Marks : 100

Answer any ***five*** questions.

1. a) How rivers can be classified according to their geology? What are the characteristics of rivers?
   b) Write down the different steps of Bending.
   c) The figure below 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.



   d) What is the relation between radius of curvature, depth of the channel and cost of constructing protection structures in rivers?
   e) What are the characteristics of a crossing?
   f) What do you mean by river morphology?

3+3+4+4+4+2 = 20

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

6+7+7= 20

3. a) What do you mean by dredging?
   b) What are the major problems associated with the disposal of dredged materials and where does the dredged materials are usually disposed?

c) Mention five important uses of dredging.

d) What is dredging sequence? Discuss.

e) What are the common reasons for failure of gabions?

2+4+5+5+4= 20

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

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

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 10 m 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) Derive the characteristic equations using Method of Characteristics (MOC) for a unit width, wide rectangular channel having gradually varied unsteady flow without lateral inflow.

$$\frac{dx}{dt} = V \pm C \quad \text{and} \quad \frac{d}{dt}(V \pm 2C) = g\left(S_0 - S_f\right)$$

b) Explain the characteristics-grid method to determine coordinate, velocity, celerity and time at a new point assuming the values for two known points.

b) Explain the Diffusing 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.

8+6+6= 20

6. 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

7. a) Sketch and differentiate between "region of constant state" and "simple wave region".

b) 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:

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

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.

3+10+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