

M.E. (Water Resources & Hydraulic Engineering) Examination, 2025
(2nd Semester)

RIVER HYDRAULICS & ENGINEERING

(Paper XI)

Time : Three Hours

Full Marks : 100

Answer any **four** questions.

1. a) Differentiate between GVUF and RVUF with examples.
c) Derive the equations of continuity and motion for GVUF considering lateral inflow.
c) What do you mean by quasi-steady flow?

4+18+3= 25

2. a) Derive the differential equation for a monoclinal rising wave.
b) What do you mean by positive and negative Riemann invariants in MOC?
c) What is dredging sequence? Discuss.
d) Factors considered in developing a dredging operation?

11+4+5+5= 25

3. a) In the case of positive surge moving downstream, derive the relation between celerity and pre-surge velocity in terms of pre-surge and post-surge flow depths.
b) In a river, the depth and velocity of flow are 0.9 m and 1.25 m/s, respectively. Due to tidal action, a tidal bore of height 1.2 m is observed to travel upstream. Estimate the height and speed of the bore and the velocity of the river after the passage of the bore.
c) Give an example of negative surge moving upstream with a neat sketch.
d) In the case of a simple wave region, prove the following relationship

$$\frac{dx}{dt} = 3C_c + U_o - 2C_o$$

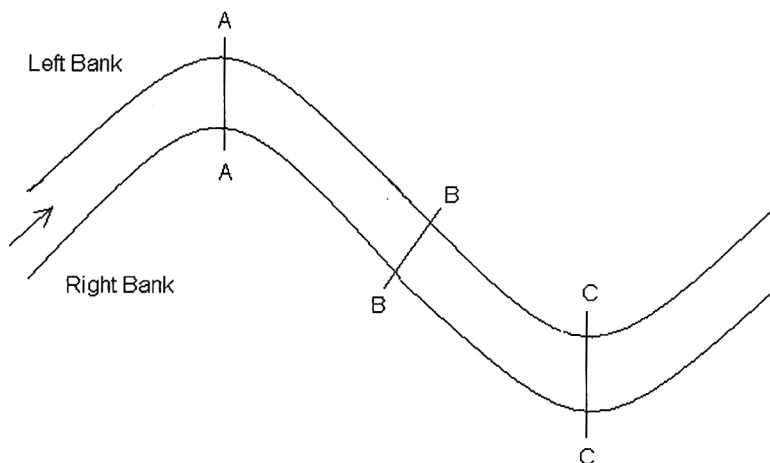
10+7+3+5= 25

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4. a) Derive and explain the Kleitz Seddon Law.
 b) Explain the diffusive and dynamic wave using neat sketches.
 c) An observer measures the flow depth in a 50 m wide rectangular river inclined at a bed slope of 3×10^{-3} with a Mannings coefficient of 0.03. Initially, the flow depth is 1.0 m, and the water level changes at a rate of 1 m/h. Calculate (i) the initial discharge at a distance of 1 km upstream, (ii) relative magnitude of the acceleration terms in the St. Venant equation and (iii) determine whether the flood wave attenuates as it propagates downstream.

4+10+11 = 25

5. a) How rivers can be classified according to their geology?
 b) What are the characteristics of meandering?
 c)



The figure above 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) Mention the relationship established by Lane (1957) and explain the difference between meandering channel and braided channel with appropriate figure?
 e) What are the steps of formation of a cut-offs?
 f) What do you mean by dredging?
 g) Mention four important uses of dredging.

3+5+3+4+4+2+4 = 25

6. a) Describe in details the sudden injection and constant rate injection - dilution method of stream flow measurement.
 b) List the qualities of a good tracer for use in dilution technique of flow measurement.

- c) Explain in details the ultrasonic method of streamflow measurement?
- d) The following are the data obtained in a stream-gauging operation. A current meter with a calibration equation $V = (0.3N + 0.03)$ m/s, where N = revolutions per second and was used to measure the velocity at 0.6 depth. Calculate the discharge in the stream.

Distance from right bank (m)	0	2	4	6	8	10	12	14	16
Depth (m)	0	0.5	1.1	1.75	2.05	1.65	1.4	0.75	0
Number of revolutions	0	80	85	125	139	115	105	70	0
Observation time (s)	0	180	120	120	120	120	120	150	0

$$7+2+4+12 = 25$$