

- (b) Write down the basic principles of the SVF. Give the classification of SVF. Explain the flow over side-weir and bottom-rack. How the discharge is estimated through a bottom rack ?
- (c) A rectangular channel 1.5 m wide conveys a discharge of 1.7 m³/s at a depth of 0.6 m. A uniformly discharging side weir with crest at 0.42 m above the bed at the commencement of the side weir is proposed to divert a flow of 0.30 m³/s laterally. Design the length of the side weir and other geometry of the channel at the weir.

5 Attempt any TWO parts of the following : 2×10

- (a) Explain the factors affecting culvert flow. With neat sketches, classify the culvert flow with outlet unsubmerged conditions.
- (b) A 5 m wide rectangular canal carries a discharge of 10 cumecs at a flow depth of 1.25 m and has a manning's roughness coefficient as 0.015. It has a bend with centreline radius of 30m and included angle of 45°. Find the superelevation.
- (c) For a sudden horizontal contraction transition, prove that,

$$F_1^2 = \frac{y_2 \left[\left(\frac{y_2}{y_1} \right)^2 - 1 \right]}{2 \left[\left(\frac{y_2}{y_1} \right) - \left(\frac{b_1}{b_2} \right) \right]}$$



(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 100758

Roll No.

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B. Tech.

(SEM. VII) (ODD SEM.) THEORY
EXAMINATION, 2014-15

OPEN CHANNEL FLOW

Time : 3 Hours]

[Total Marks : 100

- Notes :**
- (1) Attempt all questions.
 - (2) Marks and number of questions to be attempted from the section is mentioned before each section.
 - (3) Assume missing data suitably. Illustrate the answers with suitable sketches.

1 Attempt any FOUR parts of the following : 5×4

- (a) Differentiate between normal depth and critical depth in open channel flow.
- (b) While measuring the discharge in a small stream it was found that the depth of flow increases at a rate of 0.10 m/h. If the discharge at that section was 25 m³/s and the surface width of the stream was 20 m, estimate the discharge at a section 1 km upstream.

- (c) What do you mean by 'hydraulically efficient channel section'? Explain.
- (d) For a rectangular channel of width $B = 2.0\text{m}$, calculate the critical depth and the corresponding specific energy for a discharge of $6.0\text{m}^3/\text{s}$. A rectangular channel section is to be critical.
- (e) A rectangular channel 2.5 m wide has a specific energy of 1.50 m when carrying a discharge of $6.48\text{m}^3/\text{s}$. Calculate the alternate depths and corresponding Froude numbers.
- (f) What is First Hydraulic Exponent (M) and discuss its significance.

2 Attempt any FOUR parts of the following : 4×5

- (a) Discuss the classification of flow profiles.
- (b) Show that the differential equation of gradually varied flow in a rectangular channel of variable width B can be expressed as :

$$\frac{dy}{dx} = \frac{S_0 - S_f + \left(\frac{Q^2 y}{gA^3} \frac{dB}{dx} \right)}{1 - \frac{Q^2 B}{gA^3}}; \text{ with all usual notations.}$$

- (c) A spillway discharges a flood flow at a rate of $7.75\text{m}^3/\text{sec}$ per meter width. At the downstream, horizontal apron the depth of flow found to be 0.50m . What tail water depth is needed to form a hydraulic jump? If a jump is formed, find its (i) type (ii) length (iii) height (iv) energy loss as a percentage of the initial energy.
- (d) Explain the direct integration of gradually varied flow differential equation by analytical method.

- (e) Define control section. Show control sections in gradually varied flow profiles with the help of sketches.
- (f) Write down the limitations of the equation of gradually varied flow.

Attempt any TWO parts of the following : 2×10

- (a) A sluice gate in a 3.0 m wide rectangular, horizontal channel releases a discharge of $18.0\text{ m}^3/\text{s}$. The gate opening is 0.67 m and the coefficient of contraction can be assumed as 0.6 . Examine the type of hydraulic jump when the tailwater is (i) 3.60 m , (ii) 5.00 m and (iii) 4.09 m .

- (b) Write down the characteristics of rapidly varied flow. How RVFs can be utilized for flow measurement purposes?

A rectangular channel 2.0 m wide has a discharge of $0.350\text{ m}^3/\text{s}$. Find the height of a rectangular weir spanning the full width of the channel that can be used to pass this discharge while maintaining an upstream depth of 0.850 m .

- (c) Write short notes on following :
- (i) Celerity of the gravity wave, deep and shallow water waves.
- (ii) Open channel positive and negative surge.

4 Attempt any TWO parts of the following : 2×10

- (a) Show that in a hydraulic jump formed in a horizontal, frictionless rectangular channel. The energy loss relative to the critical depth y_c can be expressed as

$$\left(\frac{E_L}{y_c} \right)^3 = \frac{(a-1)^9}{32(a+1)a^4} \text{ where } a = \text{sequent depth}$$