B. Tech.
(SEM. VIII) EXAMINATION, 2006-07
OPEN CHANNEL FLOW

Time : 3 Hours] [Total Marks : 100

Notes :  
(1) Attempt all the questions. All questions carry equal marks.
(2) Use illustrations, wherever needed.
(3) Assume missing data suitably, if any and state the assumptions made.

1. Attempt any four parts of the followings : 5×4=20
   (a) While measuring the discharge is a small stream, it was found that the depth of flow increase at the rate of 0.20 m/h. If the discharge at that section was 30 m³/sec and the surface width of the stream was 20 m. Estimate the discharge at a section 1.5 km upstream.
   (b) The velocity distribution along a vertical in a channel is expressed as \( \frac{v}{v_{\text{max}}} = \left( \frac{y}{y_0} \right)^{\frac{1}{n}} \) find the values of 'α' and 'β' where 

\[
 y_0 = \text{depth of flow}, \quad v_{\text{max}} = \text{maximum velocity} \\
 v = \text{velocity at any height} \quad y \quad \text{above the bed} \\
 n = \text{a constant}
\]

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(c) Distinguish between with neat sketches (any two)
(i) Uniform flow and critical flow
(ii) Rigid channels and mobile boundary channels
(iii) Tranquil flow and shooting flow
(d) Calculate the bottom width of a rectangular channel required to carry a discharge of 20 m$^3$/s as a critical flow at a depth of 1.5 m. Also determine the froude number for this flow condition.
(e) Show that in a triangular channel the froude number corresponding to alternate depths are given by
\[ \frac{F_1}{F_2} = \left[ \frac{4 + r_1^2}{4 + r_2^2} \right]^{5/2} \]
(f) Enlist the factors on which Manning's roughness coefficient "n" depends. Show that a hydraulically efficient triangular channel section has \( Re = \frac{y_e}{2\sqrt{2}} \)
where \( Re \) = hydraulic radius and \( y_e \) = depth of flow, for the best section.

2. Attempt any two parts of the following : 10×2=20
(a) What is the essential difference between GVF and RVF? In a rectangular channel 12 m wide and 3.6 m deep water is flowing with a velocity of 1.2 m/s. The bed slope of the channel is 1 in 4000. If flow of water through the channel is regulated in such a way that energy line is having a slope of 0.0004, find the rate of charge of depth of water in the channel.
(b) Explain Chow's method for direct integration of GVF differential equation.
(c) (i) Sketch the GVF profiles produced on upstream and downstream of a sluice gate introduced on a (i) steep slope and (ii) mild slope.

(ii) A rectangular channel with a bottom width of 4.0 m and a bottom slope of 0.0008 has a discharge of 1.5 m³/s. In a GVF in this channel, the depth at a certain location is found to be 0.30 m. Assuming n = 0.016, determine the type of GVF profile.

3. Attempt any two parts of the following: 10×2=20
   (a) Derive the differential equation of Spatially Varied Flow (SVF) with increasing discharge. Clearly state the assumptions made.
   (b) What is a side or lateral weir. Give the classification of flow over side weirs with neat sketches and salient points.
   (c) (i) Differentiate between the different types of flows over bottom racks with neat sketches.
   (ii) Show that a control section where critical depth occurs in a frictionless lateral spillways channel

\[
\frac{S_o^2 g A c T_c}{4 \beta q_{g^2}} = 1
\]

4. Attempt any two parts of the following: 10×2=20
   (a) Differentiate between free and submerged jump.
   Water flows in a horizontal rectangular channel, with a velocity of 8.0 m/s at a depth of 1.0 m. Find the sequested depth and the energy loss in the jump.
(b) Explain the following characteristics of jump in a rectangular channel:
(i) Length of the jump
(ii) Water surface profile
(iii) Velocity profile with horizontal floor
(c) A sluice gate in a 3.0 m wide rectangular horizontal channel releases a discharge of 18 m³/s. The gate opening is 0.67m and the coefficient of contraction can be assumed to be 0.6. Examine the type of the jump formed when tail water is 5.0m. Also find the value of submergence factor.

5. Attempt any two parts of the following: \[10 \times 2 = 20\]
(a) Differentiate with neat sketches and examples
   (i) Prismatic and non-prismatic flows.
   (ii) Flow in channels of linear and non-linear alignments
(b) With the help of neat sketches, explain the different kinds of culvert flow.
(c) Differentiate between combining and dividing flow through a channel junction. Why it is difficult to analyze such type of flows theoretically? State the Taylor's assumptions for subcritical flow passing through the channels at a junction.