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ET-533(B)

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B.TECH. CIVIL (WATER RESOURCES ENGINEERING)

Term-End Examination

June, 2013

ET-533(B) : OPEN CHANNEL FLOW

Time : 3 hours *Maximum Marks : 70*

Note : *Attempt **any five** questions. All question carry marks as indicated. **Use** of calculator is permitted. Assume appropriate data if not given.*

1. (a) Why is the flow necessarily non - uniform in a channel of zero bed slope ? 3

   (b) Classify the following flows as uniform, gradually varied, rapidly varied, specially varied or unsteady flow with reasons : 5

   (i) Flow upstream of a dam.

   (ii) Progress of a tidal wave in an estuary

   (iii) Flow in a unlined canal considering evaporation and seepage losses

   (iv) Flow near an ungated end of a laboratory flume.

   (v) Flow over a weir.

(c) Given a trapezoidal channel with a bottom width of 3.3 m, side slope of 1.5:1, a longitudinal slope of 0.0016 and an estimated value of n = 0.13, find the normal depths of flow at a discharge of $8m^3/sec$. 6

2. (a) Show that the relation between the alternate depths in a rectangular channel is $(2h_1^2h_2^2) / (h_1+h_2) = h^3C$ 7

(b) A sewer pipe is proposed to be laid on a slope of 1 in 2500 and is required to carry $1.5m^3/sec$. What size of a circular pipe should be used if it has to flow halffull ? Assume n = 0.015. 7

3. (a) Classify and characterise the various water surface profiles obtained in steady gradually varied flow in a prismatic channel. 8

(b) Sketch the possible GVF profiles in the following serial arrangement of channels and controls. The flow is from left to right. 6

(i) Mild slope followed by a milder slope and a steep slope

(ii) Mild slope followed by a short horizontal channel and a steep slope

(iii) Steep slope followed by a critical slope and a mild slope.

4. (a) The normal depth of flow of water in a 1.5m wide rectangular channel is 1.0m. The bed slope of the channel is 0.0006 and mannig's roughness coefficient n = 0.012. Find the critical depth. At a certain section of the same channel the depth is 0.92m while at a second section the depth is 0.86m. Find the distance between the two sections (use one reach in the calculation). Also find whether the section is located d/s or u/s with respect to the first section. **2+6+1=9**

(b) Briefly compare Direct step method and standard step method for computation of water surface profile. 5

5. (a) Discuss the circumstances which may lead to the formation of surge waves in an open channel. 7

(b) A rectangular channel carries a flow at a depth of 2.5m with a velocity of 2.0m/sec. The flow is suddenly quadrupled, due to an arrangement on the downstream side by an abrupt opening of a head gates. What is the type of the resulting surge ? Determine the final depth of flow, height of the surge, celerity, wave spead and over run. 7

6. (a) Show that the froude number F_1 and F_2 in a hydraulic jump occurring in a rectangular channel are related by : 4+4=8

(i) $$F_2^2 = (8F_1^2) / \left(-1+\sqrt{1+8F_1^2}\right)^3$$

(ii) $$F_1^2 = (8F_2)^2 / \left(-1+\sqrt{1+8F_2^2}\right)^3$$

(b) A discharge of $15m^3/sec$ flows with a depth of 1.5m in a rectangular channel 5m wide. At a down stream section the width is reduced to 4.5m and the channel bed is raised by Δz. What will be the state of water surface elevation in the transition when $\Delta z = 0.10m$? 6

7. (a) Enlist the forces that act on a structure due to wave action. 7

(b) Discuss the method of characteristic. 7

8. Write short notes on ***any four*** of the following : 4x3½=14

(a) Hydraulic jump

(b) Channel Transitions

(c) Dam break problem

(d) Momentum principle

(e) Wave spectrum

(f) Surges and their classification

(g) Morrison's equation and its significance

(h) Wave force on structures.
