# B.Tech. Civil (Water Resources Engineering)

## Term-End Examination

## December, 2006

## ET-533(B) : OPEN CHANNEL FLOW

*Time : 3 hours* *Maximum Marks : 70*

***Note :*** *Solve any **five** questions. All questions carry equal marks. Give neat and labelled sketches in support of your answer. Use of calculator is allowed.*

**1.** (a) A circular channel has a diameter of 1·0 m, and runs a water depth of 0·75 m. Calculate the top width (T) of the free surface of water. Hence, find the angle θ that 'T' makes with the centre of this pipe section; give θ in degrees, minutes, and seconds. *7*

(b) A trapezoidal section has b = 2 m, and a side slope of 1 : 2. If the depth of flow, y = 1·5 m, calculate P and Z of this section. *7*

**2.** (a) Explain what do you understand by the uniform flow and normal depth of flow. *4*

(b) Given a trapezoidal channel with a bottom width of 4·1 m, side slopes of 2 : 1, a longitudinal slope of 0·0015, and Manning's n = 0·014. Find its normal discharge if normal depth is 1·9 m. *10*

**3.** (a) Determine the subcritical sequent depth of flow for a hydraulic jump with incoming water Froude number of 1·5 and supercritical flow depth of 1 m. *4*

(b) Assuming Chezy's coefficient, C, to be constant in a wide rectangular open channel with $\alpha = 1$, and the slope to be critical for a given Q, show that :

$$dy/dx = S_c.$$ *10*

**4.** A flow of 17·0 $m^3/s$ passes through a rectangular channel with the following parameters :

$$y_1 = 1{\cdot}8 \text{ m}; \; b_1 = 4{\cdot}0 \text{ m}$$

At a d/s section the width of the channel is reduced to 3·5 m, and the channel bed is raised by $\Delta Z = 0{\cdot}05$ m. Find out the equation for determining the depth of flow at the d/s section. *14*

**5.** Derive the general equation for wave velocity of a rapidly varied uniformly progressive flow : *14*

$$V_w = \left[\frac{(A_2\bar{y}_2 - A_1\bar{y}_1)g}{A_1\left(1 - \frac{A_1}{A_2}\right)}\right]^{1/2} + (V_1)$$

symbols carry their usual meaning.

**6.** (a) With respect to a progressive wave, discuss its formulation as boundary value problem, and state the boundary conditions. 7

(b) Discuss wave celerity, length and period relationships with reference to wave propagation in an open channel. 7

**7.** Write short notes on any ***two*** of the following : $2 \times 7 = 14$

(i) Dynamic equation of a uniformly progressive flow

(ii) Method of characteristics

(iii) Dam-break problem