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ET-533(B)

B.Tech. Civil (Water Resources Engineering)

Term-End Examination

00482

December, 2016

ET-533(B) : OPEN CHANNEL FLOW

Time : 3 hours *Maximum Marks : 70*

Note : *Attempt any **five** questions. All questions carry equal marks. Use of scientific calculator is permitted.*

1. (a) Derive the basic equation of continuity for unsteady open channel flow in the following form : 5

$$\frac{\partial Q}{\partial x} + T\frac{\partial y}{\partial t} = 0$$

(b) A trapezoidal channel carries a discharge of 7·1 m^3/sec. If the bottom width of the channel is 3 m, side slope is 1·5 : 1 and longitudinal slope is 0·0016, calculate the depth of flow. The value of Manning's Roughness coefficient (n) is 0·13. 9

2. (a) Derive the equation governing the critical flow condition for constant discharge situation. *6*

(b) Calculate the critical depth and the corresponding specific energy for the discharge of 5·0 m^3/sec in a rectangular channel of bottom width 2·0 m. *8*

3. (a) Derive the basic differential equation of Gradually Varied Flow (GVF) in the following form : *7*

$$\frac{dy}{dx} = \frac{S_0 - S_f}{1 - \frac{\alpha Q^2 T}{gA^3}}$$

where

S_0 = bed slope

S_f = slope of energy line

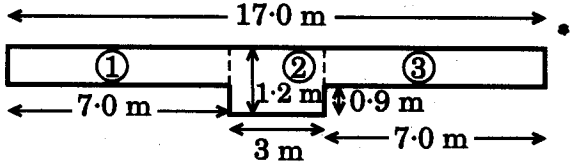
Q = discharge

A = cross-sectional area

α = kinetic energy correction factor

T = top width of the channel

(b) For the compound channel shown in the figure, determine the discharge for the depth of flow of 1·2 m. Use partial area discharge method. Assume n = 0·02 and S_0 = 0·0002. *7*



4. A discharge of 16·0 m^3/sec flows with a depth of 2·0 m in a rectangular channel which is 4·0 m wide. At a downstream section, the width is reduced to 3·5 m and the channel bed is raised by ΔZ. Analyse the water surface elevations in the transition, if $\Delta Z = 0{\cdot}20$ m. *14*

5. (a) Derive the equation for normal depth (Y_0) in a wide rectangular channel. *6*

(b) Discuss the mechanics of surges. Also derive the equation for the wave velocity. *8*

6. A rectangular channel carries a flow at a depth of 2·5 m with the velocity of 2·0 m/sec. The flow is suddenly quadrupled, due to an urgent requirement on the downstream side, by an abrupt opening of a head gate. What will be the type of resulting surge ? Determine the final depth of flow, height of the surge, clarity wave speed and overrun. *14*

7. (a) Discuss the various wave parameters. Also list the assumptions of first order wave theory. *6*

(b) Classify the water waves based on the relative depth. Also discuss the characteristics of each wave type. *8*

8. List the assumptions for the uniformly progressive flow in open channel. Derive the dynamic equation of uniformly progressive flow in open channel in the following form : *14*

$$\frac{dy}{dx} = \frac{S_0 - S_f}{\left[1 - \frac{Q^2 r}{gA^2 D}\right]}$$