[Total No. of Questions - 9] [Total No. of Printed Pages - 4] (2125)

15321

B. Tech 7th Semester Examination

Open Channel Flow (NS)

CE-411(c)

Time : 3 Hours **Max. Marks : 100**

The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/continuation sheet will be issued.

Note : Attempt five questions in all, select one question from each sections A, B, C and D. Section E is compulsory.

SECTION - A

1. (a) Explain various types of open channel flow. (5)

   (b) The width of a horizontal rectangular channel is reduced from 3.5 m to 2.5 m and the floor is raised by 0.25 m in elevation at a given section. At the upstream section, the depth of flow is 2.0 m and the kinetic energy correction factor α is 1.15. If the drop in the water surface elevation at the contraction is 0.20 m, calculate the discharge if (a) the energy loss is neglected, and (b) the energy loss is one-tenth of the upstream velocity head. [The kinetic energy correction factor at the contracted section may be assumed to be unity]. (15)

2. (a) Differentiate between the following with neat sketches.

   (i) Prismatic and non-prismatic channels.

   (ii) Rigid and mobile boundary channels. (5×2=10)

[P.T.O.]

   (b) The velocity distribution along a vertical axis in a channel can be expressed as $v/v_{max}=(y/y_0)^{1/2}$ where y_0 = depth of flow, v = velocity at any height y above the bed and n = a constant. Find the value of α and β. (10)

SECTION - B

3. (a) A channel has multiple-roughness types in its perimeter. Assuming that the total discharge in the channel is equal to the sum of discharges in the partial areas, show that the equivalent roughness is given by

$$n = \frac{PR^{5/3}}{\sum_1^N \frac{P_i R_i^{5/3}}{n_i}} \quad (10)$$

   (b) If y_1 and y_2 are alternate depths in a rectangular channel show that

$$\frac{2y_1^2 y_2^2}{(y_1 + y_2)} = y_c^3$$ And hence the specific energy,

$$E = \frac{y_1^2 + y_1 y_2 + y_2^2}{(y_1 + y_2)} \quad (10)$$

4. (a) A rectangular channel is 3.5 m wide and conveys a discharge of 15.0 m^3/s at a depth of 2.0 m. It is proposed to reduce the width of the channel at a hydraulic structure. Assuming the transition to be horizontal and the flow to be frictionless determine the water surface elevations upstream and downstream of the constriction when the constricted width is (a) 2.50 m and (b) 2.20 m. (10)

   (b) Prove that the alternate depths in an exponential channel ($A = k_1\ y^a$) the minimum specific energy E_c and critical depth y_c are related as

$$\frac{E_c}{y_c} = 1 + \frac{1}{2a} \quad (10)$$

SECTION - C

5. (a) What is Gradually-varied flow theory? Derive the governing equation for gradually varied flow. (10)

   (b) A river 100 m wide and 3.0 m deep has an average bed slope of 0.0005. Estimate the length of the GVF profile produced by a low weir which raises the water surface just upstream of it by 1.50 m. Assume n = 0.035. (10)

6. (a) Sketch the GVF profiles produced on the upstream and downstream of a sluice gate introduced in a

   (i) Steep slope (ii) mild slope and (iii) horizontal-bed channel (10)

   (b) Using the basic differential equation of GVF, show that dy/dx is positive for S_1, M_3 and S_3 profiles. (10)

SECTION - D

7. (a) A rectangular channel carrying a supercritical stream is to be provided with a hydraulic jump type of energy dissipater. If it is desired to have an energy loss of 5 m in the jump when the inlet Froude number is 8.5, determine the sequent depths. (10)

   (b) An overflow spillway is to be designed to pass a discharge of 2000 m^3/s of flood flow at an upstream water surface elevation of 200.00 m. The crest length is 75.0 m and the elevation of the average stream bed is 165.00 m. Determine the design head and profile of spillway. (10)

8. (a) A rectangular channel 2.0 m wide has a discharge of 0.350 m^3/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 0.850m. (10)

   (b) A hydraulic jump occurs in a horizontal rectangular channel with sequent depths of 0.70 m and 4.2 m. Calculate the rate of flow per unit width, energy loss and initial Froude number. (10)

SECTION - E

9. Answer following questions:

   (a) When does the steady flow in an open channel exist?

   (b) What do you mean by the term “spatially-varied flow”?

   (c) Define the term specific energy.

   (d) What do you mean by critical depth?

   (e) What is the value of first hydraulic exponent M for a rectangular channel?

   (f) Write and explain Manning’s equation.

   (g) Write down the Darcy-Weisbach equation for pipe flow.

   (h) Define uniform open channel flow

   (i) Enlist the characteristics of jump in a rectangular channel.

   (j) What do you mean by one-dimensional method of flow analysis? (10×2=20)