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CE 1317 E 012

Roll No. of candidate | | | | | | | | | | |

2018

B.Tech. 7th Semester End-Term Examination

OPEN CHANNEL FLOW — Elective – I

Full Marks – 100 Time – Three hours

The figures in the margin indicate full marks for the questions.

Answer Question No. 1 and any *six* from the rest.

1. Answer the following MCQ : $(10 \times 1 = 10)$

(i) For a given discharge in a channel, at critical depth

(a) The total energy is minimum

(b) The total energy is maximum

(c) The specific energy is maximum

(d) The specific energy is minimum

(ii) A hydraulic jump occurs when there is a break in grade from a

(a) Mild slope to steep slope

(b) Steep slope to mild slope

(c) Steep slope to steeper slope

(d) Mild slope to milder slope

(iii) If the Froude number of a hydraulic jump is 5.50, it can be classified as

(a) An oscillating jump

(b) A weak jump

(c) A strong jump

(d) A steady jump

(iv) The relationship between Manning's co-efficient 'n' and Chezy's co-efficient 'C' is given by

(a) $C = \frac{R^{\frac{2}{3}}}{n}$ (b) $C = \frac{R^{\frac{1}{6}}}{n}$

(c) $C = \frac{R^{\frac{1}{3}}}{n}$ (d) $C = \frac{R^{\frac{1}{4}}}{n}$

where R = hydraulic radius.

(v) For any channel section, the specific energy increases with

(A) Increase in depth of sub critical flow

(B) Increase in depth of super critical flow

(C) Decrease in depth of sub critical flow

(D) Decrease in depth of super critical flow

The correct answer is

(a) Both (A) and (B) (b) Both (A) and (D)

(c) Both (B) and (C) (d) Both (C) and (D)

(vi) A rectangular open channel of width 5.0 m is carrying a discharge of 100 m^3/s. The Froude number of the flow is 0.8. The depth of flow of the channel is

(a) 4 m (b) 8 m

(c) 16 m (d) 20 m

(vii) The discharge in an open channel corresponding to critical depth at a given specific energy is

(a) Zero (b) Maximum

(c) Minimum (d) None of these

(viii) In a non-prismatic channel

(a) unsteady flow is not possible

(b) the flow is always uniform

(c) uniform flow is not possible

(d) the flow is not possible

(ix) The dimensions of Manning's n are

(a) $L^{1/6}$

(b) $L^{1/2}T^{-1}$

(c) $L^{-1/3}T$

(d) $L^{-1/3}T^{-1}$

(x) If the depth of flow changes abruptly over a small length

(a) Uniform flow

(b) Rapidly varied flow

(c) Gradually varied flow

(d) Steady flow

Answer the following questions.

2. (a) Explain briefly the different types of open channel flow. (5)

(b) The velocity distribution in a rectangular channel of width 'B' and depth of flow 'y_0' = 2m is given by $v = \left(\frac{y}{y_0}\right)^{1/2}$. Find correction coefficients α and β. (5)

(c) While measuring the discharge in a small stream it was found that the depth of flow increases at the rate of 0.10 m/h. If the discharge at a section was 25 m^3/s and the surface width of the stream was 20 m, estimate the discharge at a section 1 km upstream. (5)

3. (a) In a wide rectangular channel, if the normal depth is increased by 30%, find the increase in discharge. (4)

(b) Derive the expression for shear stress on the boundary of a channel as $\tau_0 = \rho g R S_b$ with usual notations. (4)

(c) Derive the conditions for most economic triangular channel section. (7)

4. (a) Differentiate between pipe flow and open channel flow. (5)

(b) Find the dimensions of an economic trapezoidal section of an open channel with side slopes 2 horizontal to 1 vertical, laid at a slope of 1 in 1600 to carry a discharge of 36 cumecs. Assume Chezy's coefficient 'C' = 50. (5)

(c) Determine the width and depth of the most economic channel of rectangular section to convey a discharge of 10 m^3/s at a velocity of 2.25 m/s. If Chezy's coefficient 'C' = 65, find the bed slope. (5)

5. (a) State the characteristics of the specific energy curve. (4)

(b) If 'y_1' and 'y_2' are alternate depths in a rectangular channel, show that $y_c^3 = \frac{2y_1^2 y_2^2}{(y_1 + y_2)}$. and hence the specific energy, $E \frac{- y_1^2 + y_1 y_2 + y_2^2}{(y_1 + y_2)}$. (7)

(c) Supercritical flow occurs at Froude number 'F_r' = 2 at a depth 'y' = 0.63 m in a rectangular channel. Find the critical depth 'y_c'. (4)

6. (a) Starting from the basic principle, show that at critical condition $\frac{Q^2 T}{gA^3} = 1$, with usual notation. Also show that for a rectangular channel, $E_c = \frac{3}{2} y_c$ where, y_c critical depth E_c = specific energy at critical flow. (7)

(b) With the help of neat sketches, describe the various regime of flows in alluvial stream bed. (5)

(c) Find the value of the second hydraulic exponent 'N' for a wide rectangular channel section using Manning's equation. (3)

7. (a) What are the basic assumptions involved in the analysis of gradually varied flow? Deduce the following dynamic equation of gradually varied flow with usual notations $\frac{dy}{dx} = \frac{S_b - S_f}{\left(1 - \frac{Q^2 T}{gA^3}\right)}$. (2 + 8 = 10)

(b) A rectangular channel carrying supercritical stream is to be provided with a hydraulic jump as energy dissipater. If it is desired to have an energy loss of 5 m in the jump when inlet Froude number 'F_{r1}' = 8.5, determine the sequent depths. (5)

8. (a) Show that the sequent depth ratio of a hydraulic jump in a rectangular channel is given by $\frac{y_1}{y_2} = \frac{1}{2}\left[-1\sqrt{1+8F_{r_2}^2}\right]$.

where, y_1 = depth of flow before jump

y_2 = depth of flow after jump

& R_{r2} = Froude number after jump. (7)

(b) Design a channel by Lacey's theory for a discharge of 40 cumecs. The side slope may be assumed as 1H : 1V, the average size of bed material may be taken to be 0.8 mm. (8)

9. (a) Deduce the general equation of the second hydraulic exponent in uniform flow with Chezy's equation with usual notations. (7)

(b) Water flows in a 15m wide rectangular channel at a rate of 115 m^3/s. Bed slope is 0.001and Manning's 'n' = 0.0125. A dam placed downstream raises the depth of flow to 6.8 immediately behind the dam. What is the distance upstream to a point where depth is 3.7 m. Find by two steps. (8)