9. Write short notes on any *four* of the following : 3½×4=14

(a) Boundary layer thickness

(b) Specific force

(c) Factors affecting Manning's *n*

(d) Hydraulically efficient channel

(e) Unsteady flow

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Code : 011410

B.Tech. 4th Semester Exam., 2014

HYDRAULICS AND OPEN CHANNEL FLOW

Time : 3 hours *Full Marks* : 70

Instructions :

(i) The marks are indicated in the right-hand margin.

*(ii) There are **NINE** questions in this paper.*

*(iii) Attempt any **FIVE** questions.*

*(iv) Question No. **1** is compulsory.*

1. Choose the correct option of any *seven* of the following : 2×7=14

(a) Steady flow in an open channel exists when the
- (i) flow is uniform
- (ii) channel is frictionless
- (iii) depth does not change with time
- (iv) channel bed is not curved

(b) The term alternate depth is used in open channel flow to denote the depth having the same
- (i) kinetic energy for a given discharge
- (ii) specific force for a given discharge
- (iii) specific energy for a given discharge
- (iv) total energy for a given discharge

(c) At critical depth, the discharge is

(i) minimum for a given specific energy

(ii) maximum for a given specific force

(iii) maximum for a given specific energy

(iv) minimum for a given specific force

(d) In defining a Froude number applicable to open channels of any shape, the length parameter used is the

(i) ratio of area to top width

(ii) ratio of area to wetted perimeter

(iii) depth of flow

(iv) square root of the area

(e) In a triangular channel, the value of E_c / y_c is

(i) 1·25

(ii) 2·5

(iii) 3·33

(iv) 1·5

(f) The dimensions of Manning's n are

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

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

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

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

(g) In GVF profiles as the depth $y \to y_c$

(i) $\frac{dy}{dx} \to 0$

(ii) $\frac{dy}{dx} \to \infty$

(iii) $\frac{dy}{dx} \to S_0$

(iv) $\frac{dy}{dx}$ = a finite value

(h) The direct-step method is

(i) best suited for natural channels

(ii) accurate for all step sizes

(iii) most accurate for calculating supercritical flow profiles

(iv) None of the above

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

(i) mild slope to steep slope

(ii) steep slope to mild slope

(iii) steep slope to steeper slope

(iv) mild slope to milder slope

(j) If the Froude number of a hydraulic jump is 5·50, it can be classified as

(i) an oscillating jump

(ii) a weak jump

(iii) a strong jump

(iv) a steady jump

2. Define displacement and momentum thickness of boundary layer. A flat plate of 2 m width and 4 m length is kept parallel to air flowing at velocity of 5 m/s at 15 °C. Determine the length of plate over which the boundary layer is laminar, shear at the location where boundary layer ceases to be laminar and total force on both sides on that portion of plate where the boundary layer is laminar. [Take $\upsilon = 1{\cdot}47 \times 10^{-5}\ m^2/s$ and $\rho = 1{\cdot}208\ kg/m^3$] 14

3. A rectangular channel section is to have critical flow and at the same time the wetted perimeter is to be minimum. Show that for these two conditions to occur simultaneously, the width of the channel must be equal to 8/9 times the minimum specific energy head. 14

4. Explain specific energy curve. The specific energy in a 2 m wide rectangular channel is not to exceed 1·2 m. What maximum discharge can be carried in such a channel? What longitudinal slope is required to sustain such a flow? [Assume Manning's $n = 0{\cdot}015$] 14

5. Write the basin differential equation of GVF and explain the meaning of each term. Show that for a wide rectangular channel the slope is mild or steep according to S_0 being less than or greater than

$$\left(\frac{n^2 g^{10/9}}{q^{2/9}}\right)$$ 14

6. A rectangular brick-lined channel ($n = 0{\cdot}016$) of 4 m width is laid on a bottom slope of 0·0009. It carries a discharge of 15 m^3/s and the flow is non-uniform. If the depth at section A is 2·6 m, calculate the depth at section B and 500 m downstream of A by using two steps. 14

7. A hydraulic jump occurs in a horizontal 90° triangular channel. If the sequent depths in this jump are 0·60 m and 1·20 m, estimate the flow rate and the Froude numbers at the beginning and the end of the jump. 14

8. A rectangular channel carries a discharge of 1·50 m^3/s per metre with at a depth of 0·75 m. If the certain operation of a sluice gate at an upstream section causes the discharge to increase by 33 per cent, estimate the height and absolute velocity of the positive surge in the channel. 14