7. A rectangular channel 9 m wide discharges water at normal depth 3·65 m. The bed slope is 1 in 4000 and Manning's $n = 0·017$. A dam placed downstream raises the level to a height of the profile to 6·8 m immediately behind the dam. Determine the length of the profile by single step. 14

8. Define specific force. Derive the sequent-depth ratios and energy loss equations for jump in an exponential channel having $A = k_1 y^a$, where k_1 and a are characteristic constants. 14

9. Write short notes on any *three* of the following : 14

   (a) Rigid and mobile boundary channel

   (b) Kinetic energy correction factor

   (c) Direct step method

   (d) Separation of boundary layer

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Code : 011410

B.Tech 4th Semester Exam., 2016

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 ***FIVE*** *questions in all.*

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

1. Choose and write the correct option (any *seven*) : 2×7=14

   (a) In turbulent flow, which of the following gives the exact velocity distribution?

      (i) Logarithmic distribution

      (ii) Blasius equation

      (iii) Power law with index varying

      (iv) Prandtl's one-seventh power

(b) If the Reynold's number is more than 5×10^5, the boundary layer is called

(i) laminar boundary layer

(ii) turbulent boundary layer

(iii) Either of the above

(iv) None of the above

(c) Steady flow in an open channel exists when the

(i) flow is uniform

(ii) depth does not change with time

(iii) channel is frictionless

(iv) channel bed is not curved

(d) The two alternate depths in a 4·0 m wide rectangular channel are 3·86 m and 1·0 m respectively. The discharge in the channel in m^3/s is

(i) 15

(ii) 1·5

(iii) 7·76

(iv) 31·0

(Continued)

(e) In uniform flow, there is a balance between

(i) gravity and frictional forces

(ii) gravity and inertial forces

(iii) inertia and frictional forces

(iv) inertia and viscous forces

(f) The Manning's n for a smooth, clean, unlined, sufficiently weathered earthen channel is about

(i) 0·012

(ii) 0·20

(iii) 0·02

(iv) 0·002

(g) A triangular section is hydraulically efficient when the vertex angle θ is

(i) 90°

(ii) 120°

(iii) 60°

(iv) 30°

(Turn Over)

(h) 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

(i) The direct-step method

(i) is best-suited for natural channels

(ii) is accurate for all step sizes

(iii) is most accurate for calculating supercritical flow profiles

(iv) None of the above

(j) If the Froude number of a hydraulic jump is 9·50, it can be classified as

(i) an oscillating jump

(ii) a weak jump

(iii) a strong jump

(iv) a steady jump

2. The velocity distribution in the boundary layer is given by $u/U = (y/\delta)^{1/7}$. Calculate the (a) displacement thickness, (b) momentum thickness, (c) shape factor and (d) energy thickness. 14

3. The velocity distribution along the vertical in an open channel is given by $u/y = u_m/D$. Determine the kinetic energy correction factor α and momentum correction factor β for the given velocity profile. 14

4. A 5·0 m wide rectangular channel carries a discharge of 6·4 m^3/s at a depth of 0·8 m. At a section, there is a smooth drop of 0·22 m in the bed. What is the water surface elevation downstream of the drop? 14

5. Derive the Chezy equation of resistance and also derive the relationship between Chezy coefficient C, Darcy-Weisbach friction factor f and Manning's roughness n. 14

6. A 2·6 m wide rectangular channel is lined with rough concrete (n = 0·015). The bed slope of the channel is 0·0004. If the normal depth of flow is 1·25 m, calculate the (a) conveyance of the channel, (b) discharge, (c) Froude number of the flow and (d) the average bed shear stress. 14