Code : 011410

B.Tech 4th Semester Examination, 2017

Hydraulics and Open Channel Flow

Time : 3 hours *Full Marks : 70*

Instructions :

*(i) There are **Nine** Questions in this Paper.*

*(ii) Attempt **Five** questions in all.*

*(iii) **Question No. 1 is Compulsory.***

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

1. Answer any seven questions from the following: 14

(i) When the fluid flows along the solid boundary, more and more fluid gets retarded in the vicinity of the boundary; this deceleration is due to

(a) high velocity of the fluid

(b) high velocity flow outside the boundary layer

(c) high velocity gradients which exit at and near the boundary

(d) none of the above

(ii) At critical depth

(a) the discharge is minimum for a given specific energy

(b) the discharge is maximum for a given specific force

(c) the discharge is maximum for a given specific energy

(d) the discharge is minimum for a given specific force

P.T.O.

(iii) For a given open channel carrying a certain discharge the critical depth depends on

(a) the geometry of the channel

(b) the viscosity of water

(c) the roughness of the channel

(d) the longitudinal slope of the channel

(iv) For a hydraulically-efficient rectangular section, B/y_0 is equal to

(a) 1.0 (b) 2.0

(c) 0.5 (d) 2.5

(v) The dimensions of the Darcy-Weisbach coefficient f are

(a) $L^{1/6}$ (b) LT^{-1}

(c) $L^{1/2}T^{-4}$ (d) $M^0L^0T^0$

(vi) The Manning's n for a straight concrete sewer is about

(a) 0.025 (b) 0.014

(c) 0.30 (d) 0.14

(vii) The total number of possible types of GVF profiles are

(a) 9 (b) 11

(c) 12 (d) 15

(viii) The sequent-depth ratio in a hydraulic jump formed in a horizontal rectangular channel is 16.48. The Froude number of the supercritical stream is

(a) 8.0 (b) 4.0

(c) 20.0 (d) 12.0

(ix) Seventy per cent of the initial energy is lost in a jump taking place in a horizontal rectangular channel. The Froude number of the flow at the toe is

(a) 4.0 (b) 9.0

(c) 20.0 (d) 15

(x) In a negative surge

(a) the wave velocity V_w is constant

(b) the celerity is always negative

(c) the water surface is a uniformly progressive wave

(d) the celerity varies with depth

2. A plate 450 mm X 150 mm has been placed longitudinally in a stream of crude oil (specific gravity 0.925 and kinematic viscosity of 0.9 stoke) which flows with velocity of 6 m/s. Calculate (i) the friction drag on the plate, (ii) thickness of the boundary layer at the trailing edge, and (iii) shear stress at the trailing edge. 14

3. The velocity distribution along the vertical in a channel can be expressed as $v/v_{max} = (y/y_0)^{1/n}$, where y_0 = depth of flow, v = velocity at any height y above the bed and n = a constant. Find the values of a α and β. 14

4. A 3.0 m wide rectangular channel carries a discharge of 1.85 m^3/s at a depth of 0.50 m. A contraction of the channel width is required at a certain section. Find the greatest allowable contraction in the width for the upstream flow to be possible as specified. 14

P.T.O.

5. What is critical flow condition and derive the governing equation for the critical flow conditions in a channel. Further derive the specific energy and Froude number at critical flow condition in a triangular channel. 14

6. A 3.6 m wide rectangular channel had badly damaged surfaces and had a Manning's n=0.030. As a first phase of repair, its bed was lined with concrete (n = 0.015). If the depth of flow remains same at 1.2 m before and after the repair, what is the increase of discharge obtained as a result or repair? 14

7. Derive the differential equation of Gradually Varied Flow and write its basic assumptions. Explain the classification of the flow profiles based on this equations. 14

8. An overflow spillway has its crest at elevation 125.4 m and a horizontal apron at an elevation of 95.0 m on the downstream side. Find the tailwater elevation required to form a hydraulic jump when the elevation of the energy line is 127.9 m. The Cd for the flow can be assumed as 0.735. The energy loss for the flow over the spillway face can be neglected. 14

9. A 2.5 m wide rectangular channel is carrying a flow of $5 m^3/s$ at a flow depth of 2 m. Determine the height of a surge wave and its velocity if the discharge is suddenly increased to 10 m^3/s at the upstream end. 14

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