Printed Pages : 4

ECE-043

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 100758

Roll No.

B. Tech.

(SEM. VII) (ODD SEM.) THEORY EXAMINATION, 2014-15

OPEN CHANNEL FLOW

Time : **3** Hours] [Total Marks : **100**

Notes : (1) Attempt all questions.
(2) Marks and number of questions to be attempted from the section is mentioned before each section.
(3) Assume missing data suitably. Illustrate the answers with suitable sketches.

1 Attempt any FOUR parts of the following : **5×4**

(a) Differentiate between normal depth and critical depth in open channel flow.

(b) While measuring the discharge in a small stream it was found that the depth of flow increases at a rate of 0.10 m/h. If the discharge at that 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.

(c) What do you mean by 'hydraulically efficient channel section' ? Explain.

(d) For a rectangular channel of width B = 2.0m, calculate the critical depth and the corresponding specific energy for a discharge of $6.0 m^3/s$. A rectangular channel section is to be critical.

(e) A rectangular channel 2.5 m wide has a specific energy of 1.50 m when carrying a discharge of $6.48 m^3/s$. Calculate the alternate depths and corresponding Froude numbers.

(f) What is First Hydraulic Exponent (M) and discuss its significance.

2 Attempt any FOUR parts of the following : **4×5**

(a) Discuss the classification of flow profiles.

(b) Show that the differential equation of gradually varied flow in a rectangular channel of variable width B can be expressed as :

$$\frac{dy}{dx} = \frac{S_0 - S_f + \left(\frac{Q^2 y}{gA^3}\frac{dB}{dx}\right)}{1 - \frac{Q^2 B}{gA^3}}$$; with all usual notations.

(c) A spillway discharges a flood flow at a rate of $7.75 m^3/sec$ per meter width. At the downstream, horizontal apron the depth of flow found to be 0.50m. What tail water depth is needed to form m a hydraulic jump ? If a jump is formed, find its (i) type (ii) length (iii) height (iv) energy loss as a percentage of the initial energy.

(d) Explain the direct integration of gradually varied flow differential equation by analytical method.

(e) Define control section. Show control sections in gradually varied flow profiles with the help of sketches.

(f) Write down the limitations of the equation of gradually varied flow.

3 Attempt any TWO parts of the following : **2×10**

(a) A sluice gate in a 3.0 m wide rectangular, horizontal channel releases a discharge of 18.0 m^3/s. The gate opening is 0.67 m and the coefficient of contraction can be assumed as 0.6. Examine the type of hydraulic jump when the tailwater is (i) 3.60 m, (ii) 5.00 m and (iii) 4.09 m.

(b) Write down the characteristics of rapidly varied flow. How RVFs can be utilized for flow measurement purposes ?

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 0.850 m.

(c) Write short notes on following :

(i) Celerity of the gravity wave, deep and shallow water waves.

(ii) Open channel positive and negative surge.

4 Attempt any TWO parts of the following : **2×10**

(a) Show that in a hydraulic jump formed in a horizontal, frictionless rectangular channel. The energy loss relative to the critical depth y_c can be expressed as

$$\left(\frac{E_L}{y_c}\right)^3 = \frac{(a-1)^9}{32(a+1)a^4}$$ where a=sequent depth

(b) Write down the basic principles of the SVF. Give the classification of SVF. Explain the flow over side-weir and bottom-rack. How the discharge is estimated through a bottom rack ?

(c) A rectangular channel 1.5 m wide conveys a discharge of 1.7 m^3/s at a depth of 0.6 m. A uniformly discharging side weir with crest at 0.42 m above the bed at the commencement of the side weir is proposed to divert a flow of 0.30 m^3/s laterally. Design the length of the side weir and other geometry of the channel at the weir.

5 Attempt any TWO parts of the following : **2×10**

(a) Explain the factors affecting culvert flow. With neat sketches, classify the culvert flow with outlet unsubmerged conditions.

(b) A 5 m wide rectangular canal carries a discharge of 10 cumecs at a flow depth of 1.25 m and has a manning's roughness coefficient as 0.015. It has a bend with centreline radius of 30m and included angle of 45°. Find the superelevation.

(c) For a sudden horizontal contraction transition, prove that,

$$F_1^2 = \frac{\frac{y_2}{y_1}\left[\left(\frac{y_2}{y_1}\right)^2 - 1\right]}{2\left[\left(\frac{y_2}{y_1}\right) - \left(\frac{b_1}{b_3}\right)\right]}$$