Printed pages: 02 **Sub Code: NCE 043/ ECE 043**

Paper Id | 0 | 0 | 5 | 1 | **Roll No.** | | | | | | | | | | |

B. TECH.

(SEM VII) THEORY EXAMINATION 2017-18

OPEN CHANNEL FLOW

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

Note: Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

1. Attempt *all* questions in brief. 2 x 10 = 20

a. What is laminar and turbulent flow?
b. What is compound section? Write any two methods of computations of discharge in case of compound channels.
c. What is control point?
d. What is use of side weir?
e. What are the practical applications of the hydraulic jump?
f. Write the condition for choking.
g. Write down the assumptions of rapidly varied flow.
h. What do you mean by mild slope and critical slope in open channel flow?
i. Draw the velocity distribution diagram for open channel flow.
j. What is compound channel?

SECTION B

2. Attempt any *three* of the following: 10 x 3 = 30

a. Water is flowing at a velocity of 4 m/s and depth of 5 m in a channel of rectangular section of 4 m wide. Determine the following-
   i. At downstream if there is a smooth expansion in width to 5 m; determine the depth in the expanded section.
   ii. Find the maximum allowable contraction in the width without any choking.
   iii. If the width is contracted to 3 m, what is the minimum amount by which the bed must be lowered for the upstream flow to be possible as specified?

b. Prove that the slope of free surface in gradually varied flow in open channel flow is given by:

$$\frac{dy}{dx} = So - Sf / 1 - \frac{Q^2 T}{g A^3}$$

c. Explain broad crested weir, with the help of its neat sketch. Classify the flow over a broad crested weir with an upstream sharp corner on the basis of H1/Bw value. A sharp crested suppressed weir is 1.5 m long. Calculate the height of the weir required to pass a flow of 0.75 m3/s, while maintaining an upstream depth of flow of 1.50 m.
d. What is the basic principle of spatially varied flow? Also classify the SVF. How the discharge is estimated through a side weir?
e. If a culvert is to be built across a subcritical stream, from the consideration of mechanics of flow, what factors govern the shape of the bridge piers, span and shape of abutments? Which of these factors will be different in supercritical flow?

SECTION C

3. Attempt any *one* part of the following: 10 x 1 = 10

(a) Briefly describe the energy depth relationship with a sketch diagram and derive the expression

$$\frac{Q^2 \mathrm{T}}{\mathrm{g}\, A^3} = 1$$

And also determine critical depth and minimum specific energy for a rectangular channel.

(b) i. Derive all the parameters for most efficient circular channel section.

ii. An open channel is to be designed to carry 1m3 /s at a slope of 0.0065. The channel material has an n value of 0.011. Find the optimum hydraulic cross-section for a rectangle channel.

iii.

4. Attempt any *one* part of the following: 10 x 1 = 10

(a) i. Discuss the graphical integration method in detail for working out water surface profile in an open channel flow.

ii. Explain the standard fourth order Runge-Kutta method to solve the basic differential equation of gradually varied flow.

(b) Show that the gradually flow equation is reduced to uniform flow formula if dy/dx = 0.

5. Attempt any *one* part of the following: 10 x 1 = 10

(a) Show the open channel positive and negative surge moving upstream and downstream. Also prove a relation $C = \sqrt{\mathrm{gy}}$ for a rectangular channel for the positive surge moving down stream.

(b) Write down the applications and assumptions of rapidly varied study flow and also Derive the expression.

$$\frac{y_2}{y_1} = \frac{-1 \pm \sqrt{1 + 8F_1^2}}{2}$$

6. Attempt any *one* part of the following: 10 x 1 = 10

(a) What is hydraulic jump? Discuss the application of hydraulic jump. Classify the hydraulic jump according to Froud Number.

(b) Determine the length of the back water curve caused by an afflux 2.0 m in a rectangular channel of width 40 m and depth 2.5 m. The slope of bed is given as 1 in 11000. Take Manning's N = 0.03.

7. Attempt any *one* part of the following: 10 x 1 = 10

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

(b) A rectangular concrete conduit is to be used as a culvert on a slope of 0.02. The culvert is 15 m long and has a cross-section of 2.13m x 2.13 m. If the tail water elevation is 1.8 m above the crown at the outlet determine the head water elevation necessary to pass a 10 m^3/s discharge. Assume a square-edged entrance (K. = 0.5).