15

B.Sc. Engg. (CEE)/ 5th Sem. **09 October, 2023 (Monday)**

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Mid Semester Examination Winter Semester: **AY 2022-2023**
COURSE NO. : **CEE 4565** TIME: **1.5 hrs**
COURSE TITLE: **Open Channel Flow** FULL MARKS: **75**

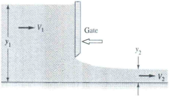
There are **3 (three) questions. Answer ALL the questions.**
The figures in the right margin indicate CO-PO and also the full marks of the question.

1.(a) (i) Show that for a channel with large slope, the pressure distribution is less that the hydrostatic pressure. CO1-PO1: **(06)**
(ii) Define: Celerity, Critical slope, and Compound section.

(b) A 4-m wide rectangular channel is carrying a discharge of 10 m³/s at a depth of 2.5 m. There is a step rise of 0.2 m in the channel bottom. Assuming there are no losses at the transition, determine the flow depth downstream of the bottom step. Does the water surface rise or fall at the step? CO1-PO1: **(07)**

(c) Water is flowing through a sluice gate as shown below. Assuming hydrostatic pressure distribution and neglecting the frictional force on the bed, show that the force F acting on the sluice gate is given by CO1-PO1: **(08)**

$$F = \frac{1}{2}\gamma\frac{(y_1 - y_2)^3}{(y_1 + y_2)}$$



(d) The velocity distribution in a channel section may be approximated by the following equation: CO1-PO1: **(09)**

$$V = V_o\left(\frac{y}{y_0}\right)^n$$

Where, V is the flow velocity at depth y, V_o is the flow velocity at depth y_o, and n is a constant. Derive the expressions for the energy and momentum coefficients.

Q.2 (a) A trapezoidal channel having a bottom width of 20 m and side slopes of 2H:1V is carrying a discharge of 60 m³/s. Assuming $\alpha = 1.1$, determine the critical depth. CO2-PO2: **(06)**

(b) (i) Show that for a trapezoidal channel of given area of flow, the condition of maximum flow requires that hydraulic mean depth is equal to one-half of the depth of flow. CO2-PO2: **(07)**

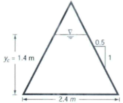
(ii) The specific energy for a 3-m wide rectangular channel is 3 kg m/kg. What will be the maximum possible depth?

(c) Show the relation between alternate depths y_1 and y_2 for a rectangular channel is given by — CO2-PO2: **(06)**

$$y_c^3 = \frac{2y_1^2 y_2^2}{y_1 + y_2}$$

Where, y_c is the critical depth. Also show that the width of the channel will be equal to 4/3 times the critical depth, when the wetted perimeter is minimum.

(d) Water is flowing in a Δ shaped channel as shown below. Critical depth is known to occur at a depth of 1.4 m in this channel. Estimate the discharge and specific energy corresponding to this critical condition in the channel. — CO2-PO2: **(06)**



Q.3 (a) A lined channel (n = 0.014) is of trapezoidal section with one side vertical and other side having a slope of 1.5H:1V. The canal needs to deliver water at a rate of 10.0 m^3/sec, when laid on a slope of 0.0001. Determine the dimensions of the efficient section which requires minimum of lining. — CO2-PO2: **(06)**

(b) Using the Newton-Raphson method, compute the normal depth and velocity for a trapezoidal channel with b = 6.0 m, z = 2, S_0 = 0.0025 and n = 0.025 and Q = 30 m^3/sec. — CO2-PO2: **(06)**

(c) A rectangular testing channel is 0.60 m wide and is laid on a slope of 0.1%. When the channel bed and walls were made smooth by neat cement, the measured normal depth of flow was 0.40 m for a discharge of 0.23 m^3/sec. The same channel was then roughened by cemented sand grains and the measured normal depth was 0.35 m for a discharge of 0.12 m^3/sec. Determine the discharge for a normal depth of 0.45 m, if the bed is roughened and the walls are made smooth. — CO2-PO2: **(05)**

(d) Deduce the expression for normal depth in a triangular channel using the Chezy formula. — CO2-PO2: **(03)**