THIRD YEAR FIRST SEMESTER EXAMINATIONS
FOR
BACHELOR OF SCIENCE IN CIVIL AND STRUCTURAL ENGINEERING

COURSE CODE: **CSE 351**
COURSE NAME: **HYDRAULICS I**

Instructions to candidates

- This paper consists of **FIVE (5)** questions
- Answer **Question ONE** and **ANY other THREE (3)** questions
- All symbols have their usual meanings unless otherwise stated
- Time allowed is **THREE (3)** hours

Question ONE Compulsory (40 marks)

a) Briefly explain the following terms as used in open channel flows
   i. Steady flow (1 marks)
   ii. Unsteady flow. (1marks)

b) Explain the term open channel. State the various types of open channels (4 marks)

c) Define the following terms with reference to discharge **Q,** normal depth **h,** critical depth $\mathbf{h_c}$ and specific energy, $\mathbf{E_s}$
   i. Subcritical flow
   ii. Critical flow
   iii. Supercritical flow (6 marks)

d) A trapezoidal channel 3.5 m wide at the bottom has side and bed slopes of 1:1 and 1 in 1000 through respectively. Using Manning's formula, find the discharge through the channel, if depth of water is 0.5 m. Take n = 0.03 (8 marks)

e) Show that for the most economical rectangular channel section, its dimensions may be found by:- (8 marks)

$$b = 2d \text{ and } R = \frac{d}{2}$$

f) Using Figure 1 shown below, show that the depth of the hydraulic jump or height of standing wave may be found by:- (12 marks)

$$d_2 = -\frac{d_1}{2} + \sqrt{(\frac{d_1^2}{4} + \frac{2{d_1}^2 V_1^2}{g})}$$

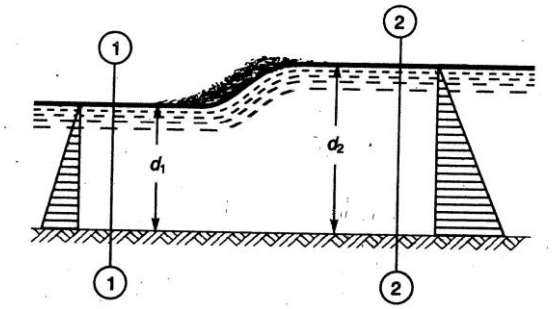

Figure 1

Question TWO (20 marks)

a) Define the term specific energy (2 marks)

b) Water is flowing through a circular channel of 1.5 m radius having bed slope of 1 in 700. Find the velocity and discharge of water through the channel, if the depth of water in the channel is 1m. Take Chezy's constant as 60 (8 marks)

a) Find the discharge of water through the channel show in Figure 2 below. The slope of the channel is 1 in 1000. Take Chezy's C as 55. What is the value of Manning's *n* for this discharge (10 marks)

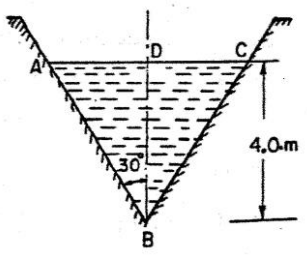

Figure 2

Question THREE (20 marks)

a) Show that for non-modular venturiflume shown in Figure 3 below, the discharge is given by:- (8 marks)

$$Q = \frac{C a_1 a_2}{\sqrt{\{a_1^2 - a_2^2\}}} \sqrt{2gh}$$

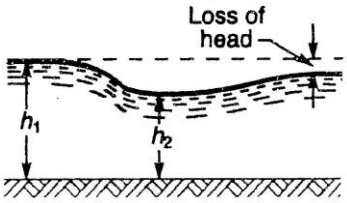

Figure 3

b) A trapezoidal channel with side slopes of 3 horizontal to 2 vertical has to be designed to convey 10 m^3/s of water at a velocity of 1.5 m/s, so that the amount of concrete lining for the bed and sides is minimum. Find

i. The wetted perimeter
ii. The slope of the bed if Manning's $n = 0.014$ (12 marks)

Question FOUR (20 marks)

a) What is a hydraulic jump? (2 marks)
b) Classify the types of flow based on the effects of viscosity and gravity. (4 marks)
c) A concrete lined circular channel of diameter 3m has a bed slope of 1 in 500. Work out the velocity and flow for conditions of:

i. Velocity and discharge for maximum velocity
ii. Velocity and maximum discharge. Take Chezy's C to be 50 (14 marks)

Question FIVE (20 marks)

a) A rectangular channel 4m wide has a modular venturiflume of throat width 1.8m. Find the discharge through the venturiflume (neglecting velocity head), when the depth of water is 1.25 m. What will be the discharge when velocity head is considered? Take coefficient for venturiflume as 0.9 (6 marks)
b) In a laboratory experiment, a Cippoletti weir having a crest length of 40 cm is used to measure the flow of water in a rectangular channel 60 cm wide and 7.5 cm deep. If the water level in the channel is 5 cm above the weir crest, estimate the discharge in the channel by considering velocity of approach. Take C_d as 0.63 (6 marks)

c) Find the discharge through the stepped notch shown in Figure 4 below. Take C_d for all section as 0.62 (8 marks)

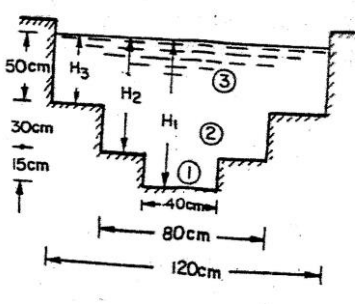

Figure 4