



# TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT BUILDING AND CIVIL ENGINEERING

**UNIVERSITY EXAMINATION FOR:**

**BSC IN CIVIL ENGINEERING**

**ECE 2304: HYDRAULICS**

**END OF SEMESTER EXAMINATION**

**SERIES: APRIL 2016**

**TIME: 2 HOURS**

**DATE: 16 May 2016**

## Instructions to Candidates

You should have the following for this examination

*-Answer Booklet, Drawing Instruments, Scientific calculator, examination pass and student ID*

This paper consists of five questions. Attempt question ONE (Compulsory) and any other TWO questions.

## **QUESTION ONE (30 marks)**

- a) Derive Chezy's equation for steady and uniform flow in open channel. **[10 marks]**
- b) Find the rate of flow and conveyance for a rectangular channel 7.5 m wide for uniform flow at a depth of 2.25 m. The channel is having bed slope as 1 in 1,000. Take Chezy's constant  $C = 55$ . **[4 marks]**
- c) Water is flowing at the rate of 16.5 cubic metres per second in an earthen trapezoidal channel with bed width 9 metres, water depth 1.2 metres and side slope 1:2. Calculate the bed slope, if the value of  $C$  in the Chezy's formula is 49.5. **[8 marks]**

- d) A channel has two sides vertical and semi-circular bottom of 3 metres diameter. Calculate the discharge of water through the channel, when the depth of flow is 3 metres. Take  $C = 67$  and slope of bed as 1 in 950.

**[8 marks]**

**QUESTION TWO (20 marks)**

- a) Derive an expression for conditions of most economical section of a rectangular channel.

**[5 marks]**

- b) A rectangular channel has a cross-section of 8 square metres, bed slope 1 in 1000. Taking Chezy's  $C=55$ , find:

- i. The size and
- ii. Discharge through the most economical channel

**[7 marks]**

- c) A trapezoidal channel has side slope 2 vertical to 3 horizontal. It is discharging water at the rate of 35 cubic metres per second with a bed slope of 1 in 2200. Design the channel for most economical section. Use Manning's formula, take  $n=0.01$ .

**[8 marks]**

**QUESTION THREE (20 marks)**

- a) Define the following types of flows in non-uniform channel and indicate then in a specific energy curve:

- i. Streaming flow
- ii. Critical flow
- iii. Shooting flow

**[4 marks]**

- b) A trapezoidal channel having a bed slope width of 7 metres and side slope 1:1 discharging water at the rate of 9.5 cubic metres per second. Calculate the specific energy of water, if the depth of flow in the channel is 2.5 metres.

**[4 marks]**

- c) A channel of rectangular section 10.5 m wide is discharging water at the rate of 15.6 cubic metres per second with an average velocity of 1.6 metres per second. Determine the type of flow.

[4 marks]

- d) A 9 m wide channel conveys 19.5 cubic metres per second of water at a depth of 1.6 m. calculate:
- Specific energy of the flowing water
  - Critical depth , critical velocity minimum specific energy
  - Froude number and state whether flow is subcritical or supercritical

[8 marks]

**QUESTION FOUR (20 marks)**

- a) What is hydraulic jump? Explain clearly how it is formed

[4 marks]

- b) What is the use of venturiflume? Distinguish between modular and non-modular venturiflumes.

[4 marks]

- c) A rectangular channel 6 metres wide discharges 1.44 cubic metres per second of water into a 6 metres wide apron, with no slope, with a mean velocity of 6metres per second.

- What is the height of the jump?
- How much energy is absorbed in the jump?

[9 marks]

- d) State conditions under which uniform and non-uniform flows are produced.

[3 marks]

**QUESTION FIVE (20 marks)**

- a) Explain the factors causing gradually varied and rapidly varied flows.

[4 marks]

- b) Describe the classification of weirs

[3 marks]

- c) Show that the flow over a triangular notch is given by:

$$Q = \frac{8}{15} C_d \sqrt{2g} \tan \frac{\phi}{2} H^{5/2}$$

[7 marks]

d) A rectangular notch 0.5 metre has a constant head of 400 mm. Taking coefficient of discharge as 0.62; find the discharge over the notch.

**[4 marks]**

e) State four advantages of triangular notch over a rectangular notch.

**[2 marks]**