



# THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

(A Constituent College of Jkuat)

*Faculty of Engineering and Technology*

**DEPARTMENT OF BUILDING AND CIVIL ENGINEERING**

**UNIVERSITY EXAMINATIONS FOR BACHELOR OF  
SCIENCE IN CIVIL ENGINEERING**

ECE 2304 : HYDRAULICS I

**END OF SEMESTER EXAMINATION**

SERIES: AUGUST/SEPTEMBER 2011

**TIME: 2 HOURS**

**Instructions to Candidates:**

You should have the following for this examination

- *Answer booklet*

This paper consists of **FIVE** questions in **TWO** sections **A & B**

Answer question **ONE (COMPULSORY)** and any other **TWO** questions

Maximum marks for each part of a question are as shown

This paper consists of **THREE** printed pages

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**SECTION A (COMPULSORY – 30 MARKS)**

**Question 1**

- a) After a flood had passed an observation station on a river, an engineer visited the site and by locating flood marks, performing appropriate surveying and doing necessary computations determined that the cross-sectional area wetted perimeter, and water surface slope at the time of the peak flooding were  $2960\text{m}^2$ ,  $341\text{m}$  and  $0.00076$  respectively. The engineer also noted that the channel bottom was “earth with grass and weeds” ( $n = 0.030$ ).

Estimate the peak flood discharge

(9 marks)

- b) A corrugated metal pipe of 500mm diameter flows half-full at a slope of 0.0050. see fig. 1. Determine the flow rate for this condition (13 marks)

250mm

- c) Calculate the discharge through a needle valve whose outlet diameter is 2.0m if the pressure just upstream of the valve is  $200\text{KN/m}^2$   
Given  $C_d = 0.68$  (8 marks)

**SECTION B** (Answer any TWO questions from this section. Each question carries 20 marks)

**Question 2**

- a) Determine the normal flow depth in a trapezoidal channel with side slopes 1 in 1.5, bottom width 7.6m and channel slope 0.00088, and if the discharge is  $42\text{m}^3/\text{s}$  and manning roughness coefficient is 0.02 (7 marks)
- b) A rectangular section channel conveys  $2.5^3/\text{s}$  flow with a bed slope of 0.0002. Determine the best hydraulic section dimensions if:
- (i) The effective surface roughness height is 3mm (5 marks)
  - (ii) The manning roughness coefficient is 0.014 (8 marks)
- c) Water flowing at the normal depth in a rectangular concrete channel that is 12m wide encounters an obstruction causing the water level to rise above the normal depth at the obstruction and for some distance upstream. The water discharge is  $128\text{m}^3/\text{s}$  and the channel bottom slope is 0.00086. The depth of water just upstream from the obstruction is 4.55m.
- (i) Find the distance upstream to the point where the surface is at the normal depth
  - (ii) Calculate the critical water depth
  - (iii) Comment on the type of flow.

### Question 3

- a) A hydraulic jump occurs downstream of a 15.5m wide sluice gate in a rectangular channel. The initial depth is 1.22m and the velocity is 18.2m/s

Determine:

- (i) The initial Froude Number and the sequent depth Froude Number  
(10 marks)
- (ii) The energy dissipated in the jump (10 marks)
- b) A 120° v-notch broad crested of height 0.3m above the channel and the length 2m was used to measure flow in a stream. What is the discharge if the upstream total energy is 0.85m. Given 1.225

### Question 4

- a) Derive the formula for discharge of a Rectangular notch (7 marks)
- b) A 15m vertical carries a design flow head of 1.5m. Determine the flow depth at the toe (5 marks)
- c) Water flows in the symmetrical trapezoidal channel lined with asphalt as shown in the figure 2 below

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The channel bottom drops 0.1ft vertically for every 100ft length.  
Calculate the water velocity and flow rate given  $n = 0.015$

(8 marks)

### Question 5

- a) Show that for a circular culvert of diameter  $D$  the velocity of flow will be maximum when the depth of flow  $h$  at the centre is  $0.81D$  (14 marks)
- b) A sewer diameter  $D = 0.6$  m has a slope so if 1 in 200. Calculate the maximum velocity of flow that can occur and the discharge at this velocity  
Take  $C = 5551$  units (6 marks)