TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF BUILDING & CIVIL ENGINEERING

UNIVERSITY EXAMINATION FOR:

BACHELOR OF SCIENCE IN CIVIL ENGINEERING

ECE 2304 : HYDRAULICS I

SPECIAL/SUPPLEMENTARY EXAMINATION

SERIES: SEPTEMBER 2018

TIME: 2 HOURS

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of five questions.

Attempt question ONE (Compulsory) and any other TWO questions

Do not write on the question paper.

QUESTION ONE (COMPULSORY) [30 marks]

a) Explain the following types of flows:

i. Uniform and non-uniform flows.

ii. Steady and unsteady flows.

[5 marks]

b) Derive Manning's equation for steady and uniform flow in open channel.

[5 marks]

c) A circular pipe of 1 metre radius is laid at an inclination of 5^0 with the horizontal. Calculate the discharge through the pipe, if the depth of water in the pipe is 0.75 metre. Take C=65.

[10 marks]

d) A canal of trapezoidal section has bed width of 7 m and bed slope of 1 in 3600. If the depth of flow is 2.6 m and side slopes of the channel are 1 horizontal to 3 vertical, determine the average flow velocity and the discharge carried by the channel. Also compute the average shear stress at the channel boundary. Take value of Chezy's constant = 65. **[10 marks]**

ANSWER ANY TWO QUESTIONS FROM THIS SECTION

QUESTION TWO [20 marks]

a) Derive an expression for condition for maximum discharge through a channel of trapezoidal section.

[7 marks]

b) Design an earthen trapezoidal channel for water having a velocity of 0.5 m/s. side slope of the channel is 1:1.5 and quantity of water flowing is $4\ m^3/s$. Assume C in Chezy's formula as 55.

[8 marks]

c) A rectangular channel has a cross–section of 9 square metres. Find its size and discharge through the most economical section, if the bed slope is 1 in 2000. Use Manning's formula, taking N = 0.013.

[5 marks]

QUESTION THREE [20 marks]

a) Define the following types of flows in non-uniform channel:
   i. Subcritical flow.
   ii. Critical flow.
   iii. Supercritical flow.

[3 marks]

b) Derive an expression for:
   i. Critical depth.
   ii. Critical velocity.

[8 marks]

c) A 8 m wide channel conveys 16.5 m^3/sec of water at a depth of 1.32 m. Calculate:
   i. Specific energy of the flowing water.
   ii. Critical depth, critical velocity and minimum specific energy.
   iii. Froude number and state whether flow is subcritical or supercritical.

[9 marks]

QUESTION FOUR [20 marks]

a) Derive an expression for the depth of hydraulic jump.

[9 marks]

b) A discharge of 1.5 cubic metres per second flows along a rectangular channel 1.5 m wide. If a standing wave is to be formed at a point, where the upstream depth is 0.18 m, what would be the rise in water level?

[4 marks]

c) Show that the flow over a triangular notch is given by:
$Q = \frac{8}{15} C_d \sqrt{2g}\ tan\frac{\emptyset}{2} H^{5/2}$ **[7 marks]**

QUESTION FIVE [20 marks]

a) Differentiate between gradually varied flow and rapidly varied flow.

[2 marks]

b) Derive an expression of discharge over a rectangular weir.

[8 marks]

c) Show that the resistance [**R**] to the motion of a sphere of diameter [**D**] moving with a uniform velocity [**V**] through a real fluid having mass density [**ρ**] and viscosity [**μ**] is given by

$$R = \rho D^2 V^2 f\left(\frac{\mu}{\rho v D}\right)$$

[10 marks]