(*University of Choice*)

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

MAIN CAMPUS

UNIVERSITY EXAMINATIONS
2014/2015 ACADEMIC YEAR

FIRST YEAR FIRST SEMESTER EXAMINATIONS

FOR THE DEGREE
OF
MASTER OF SCIENCE IN WATER RESOURCES ENGINEERING

COURSE CODE: CWE 803

COURSE TITLE: HYDRAULICS OF OPEN CHANNEL FLOW

DATE: 16TH DECEMBER 2014 **TIME: 2.00PM – 5.00PM**

INSTRUCTIONS:

1. This question paper contains **FIVE** questions.
2. Answer **ALL** questions.
3. Your workings should be logical and clear.
4. A formula sheet is attached.
5. Examination duration is **3 Hours**

MMUST observes ZERO tolerance to examination cheating

Question 1 (20 marks)

By considering velocity similitude in the Manning's and Froude's relationships, show that:

(a) For a geometrically similar model with surface fall in prototype equal to that in the model then $n_r = L_r^{1/6}$ **(8 marks)**

(b) For a geometrically similar model with s_r variable then the model can be tilted to satisfy the equation

$$s_r = \left(\frac{n_r}{L_r^{1/6}} \right)^2$$ **(6 marks)**

(c) For a distorted model $d_r = L_r \left(\frac{n_r}{L_r^{1/6}} \right)^2$ **(6 marks)**

Question 2 (20 marks)

A rectangular channel with a flat bed and width 5 m and maximum depth of 2 m has a discharge of 10 m^3/s. If the normal depth of flow is 1.25 m, determine the depth of flow in a section where the bed rises 0.2 m over a distance of 1 m. assume that friction losses are negligible. **(20 marks)**

Question 3 (20 marks)

An open channel of economical trapezoidal section with sides inclined at 60 degrees to the horizontal is required to give a discharge of 10 m^3/s when the slope is 1 in 1600. Calculate the dimensions of the cross section assuming Checy constant C = 74 in SI units. **(20 marks)**

Question 4 (20 marks)

It is required to measure the flow continuously in a long irrigation canal. The canal is 8 m wide and can sensibly be considered to have a rectangular cross section for which the Checy's C = 40 in SI units, the bed slope of the channel is 1 in 2750. A venture meter with a width of 3 m and a bed hump of height 0.6 m has been chosen for the purpose. When the depth of flow immediately upstream of the venture meter is 1.3 m, then determine the following:

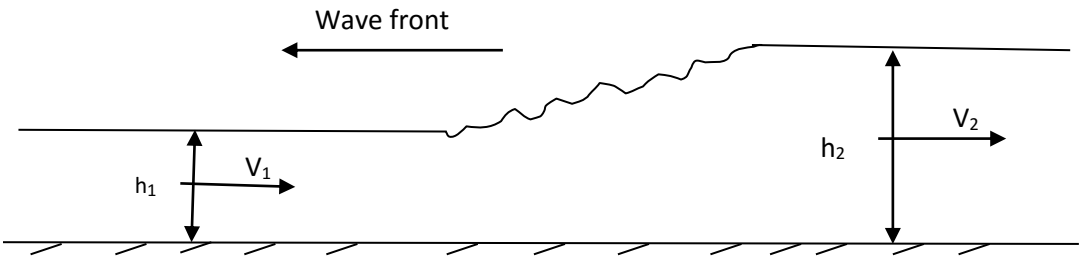
(a) The discharge in the canal. **(8 marks)**

(b) The depth of flow at the highest point of the bed hump **(6 marks).**

(c) The normal depth of flow in the canal **(6 marks).**

Question 5 (20 marks)

(a) Show that the celerity of a surge wave flowing the closure or opening of a gate valve in an open channel is given by $C = -V_1 + \left[g h_1 \left(\frac{h_2}{2h_1} \left(1 + \frac{h_2}{h_1} \right) \right) \right]^{1/2}$ where sub-scripts 1 and 2 refer to the parameters at sections 1 and 2 as shown in the figure below: **(10 marks)**



(b) A rectangular channel 6 m wide has a depth of flow of 1.5 m and carries 30 m^3/s of water discharge. The flow is suddenly reduced by 40 % due to the gate closure. Calculate the speed and height of the surge wave upstream of the gate assuming that the channel is sufficiently deep to accommodate the surge. **(10marks)**

FORMULA SHEET

Formula	Expression
Manning's Formula	$V = \frac{1}{n}.R^{2/3}.S^{1/2}$
Chezy's Formula	$Q = AC\sqrt{mi}$
Specific Energy	$E = y + \frac{V^2}{2g}$
Critical depth flumes	$Q = 1.71 C_d B(E-h)^{3/2}$
Specific Force	$F = A\bar{x} + \frac{AV^2}{g}$
Conjugate depths for rectangular channels	$\frac{y_1}{y_2} = -\frac{1}{2} + \frac{1}{2}\sqrt{1+8F_{n2}}$