(University of Choice)

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

MAIN CAMPUS

UNIVERSITY EXAMINATIONS 2022/2023 ACADEMIC YEAR

FIRST YEAR FIRST SEMESTER EXAMINATIONS

FOR THE DEGREE OF MASTER OF SCIENCE IN WATER RESOURCES ENGINEERING

COURSE CODE: CWE 803

COURSE TITLE: ADVANCED HYDRAULICS OF OPEN CHANNEL FLOW

DATE: 13TH APRIL 2023 **TIME:** 8- 11 A.M

INSTRUCTIONS:

1. This Paper Consists of FIVE Questions
2. Attempt Question any FOUR Questions
3. It is to the best interest of the candidate to write legible
4. Examination duration is **3 Hours**

MMUST observes ZERO tolerance to examination cheating

This Paper Consists of 3 Printed Pages. Please Turn Over.

QUESTION ONE [25 MARKS]

A long channel of rectangular cross-section with width 3.5 m and streamwise slope 1 in 800 carries a discharge of 15 m^3/ s. Manning's n may be taken as 0.016. A broad-crested weir of height 0.7 m is constructed at the centre of the channel. Determine:
(a) The depth far upstream of the weir;
(b) The depth just upstream of the weir
(c) Whether or not a region of supercritical gradually-varied flow exists downstream of the weir

QUESTION TWO [25 MARKS]

A venturi flume is placed near the middle of a long rectangular channel with Manning's n = 0.012. The channel has a width of 5 m, a discharge of 12.5 m^3/s and a slope of 1:2500.
(a) Determine the critical depth and the normal depth in the main channel.
(b) Determine the venturi flume width which will just make the flow critical at the contraction.
(c) If the contraction width is 2 m find the depths just upstream, downstream and at the throat of the venturi flume (neglecting friction in this short section).
(d) Sketch the surface profile

QUESTION THREE [25 MARKS]

a) A downward step of height 0.5 m causes a hydraulic jump in a wide channel when the depth and velocity of the flow upstream are 0.5 m and 10 m/s respectively. Find the downstream depth and head lost in the jump. [10 marks]
b) Water is flowing at a depth of 1.3 m and a velocity of 0.95 m/s when controlled by a sluice gate at a downstream location. The gate is abruptly dropped by 0.14 m. Find the resulting depth on the upstream part of the gate. The coefficient of contraction under the gate is 0.61. (Hint: $q = C_c\, a(2gh)^{0.5}$. [15 marks]

QUESTION FOUR [25 MARKS]

A long, wide channel has a slope of 1:2747 with a Manning's n of 0.015. It carries a discharge of 2.5 m^3/s per metre width, and there is a free overfall at the downstream end. An undershot sluice is placed a certain distance upstream of the free overfall which determines the nature of the flow between sluice and overfall. The depth just downstream of the sluice is 0.5 m.
(a) Determine the critical depth and normal depth.
(b) Sketch, with explanation, the two possible gradually-varied flows between sluice

and overfall.

(c) Calculate the particular distance between sluice and overfall which determines the boundary between these two flows. Use one step in the gradually-varied-flow equation

QUESTION FIVE **[25 MARKS]**

a) Water flows as a depth of 0.8 m of a velocity of 0.9 m/s in a wide rectangular channel in a reach immediately of a control gate. The gate is suddenly closed completely. Determine the resulting surge conditions [15 marks]

b) A sluice gate in a 3 m wide rectangular horizontal channel releases a discharge of 18 m^3/s. Gate opening is 0.67 and $C_c = 0.6$. Determine the type of hydraulic jump when tail water depth is

i) 3.6 m ii) 5.0 m iii) 4.09 m [10 marks]