TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering & Technology

DEPARTMENT OF BUILDING & CIVIL ENGINEERING

UNIVERSITY EXAMINATION FOR:
BACHELOR OF SCIENCE IN CIVIL ENGINEERING
(BSCE)

ECE 2304: HYDRAULICS I

END OF SEMESTER EXAMINATION
SERIES: APRIL 2014
TIME ALLOWED: 2 HOURS

Instructions to Candidates:
You should have the following for this examination
- *Answer booklet*

This paper consists of **FIVE** questions. Answer any **THREE** questions of the **FIVE** questions
All questions carry equal marks
Maximum marks for each part of a question are as shown
This paper consists of **TWO** printed pages

Question One

a) Explain the term supercritical flow and uniform flow in connection with open channels.

b) Define the term critical velocity and derive an expression for the critical velocity in any channel in terms of the discharge Q, the area of cross-section A, and width of water surface B.

c) By applying the principle of total energy of flow in an open rectangular channel show that the water surface profile can be estimated using the expression:

$$\frac{dd}{dx} = S_o \left[\frac{1 - \left(dn/d \right)^{10/3}}{1 - \left(\frac{dc}{d} \right)^3} \right]$$

d) Show that in a rectangular channel, the critical depth is two-thirds of the specific energy E, and that the Fraude Number NF for critical depth conditions is unity.

e) Water flows in a channel of rectangular section with velocity of 1.5m/s and depth of 1.2m. Determine:

- **(i)** The critical depth
- **(ii)** The specific energy of the flow
- **(iii)** The maximum discharge under critical flow conditions of the channel is 3m wide

Question Two

a) Show that in a rectangular channel, the critical depth is two-thirds of the specific energy E, and that the Froude Number NF for critical depth conditions is unity

b) Water flows in a channel of rectangular section with velocity of 1.5m/s and depth of 1.2m. Determine:

- (i) The critical depth
- (ii) The specific energy of the flow
- (iii) The maximum discharge under critical flow conditions of the channel is 3m wide

Question Three

A long rectangular open channel 3.0m wide carries a discharge of 20m3/sec. The channel slope is 0.005 and the manning's coefficient is 0.01. At a certain point in the channel where the flow reaches the normal depth.

- **(i)** Determine the state of the flow, it is supercritical or subcritical
- **(ii)** If a hydraulic jump takes place at this depth what is the sequent depth at the jump?
- **(iii)** Estimate the energy head loss through the jump

Question Four

The following data was obtained to determine the effect of algae growth in a trapezoidal concrete-lined irrigation channel laid between the stations A and B.

- Bottom width = 1.0m
- Side slope = 1 in 1
- Top width of water surface = 2m
- Discharge Q = 1.5m^3/sec
- Elevation at station A is 875.13m above mean sea level
- Elevation at station B is 863.47m above mean sea level
- Distance between station A and B is 2km

Determine the value of Manning's coefficient n

Question Five

It is believed that the volumetric discharge Q through an orifice is dependent on the fluid coefficient of dynamic viscosity μ the fluid density ρ, the orifice diameter d, the head over the orifice H and gravitational acceleration g. Show by means of dimensional analysis that $Q = C_D A\sqrt{2gH}$ where A is the area of orifice and CD is a function of the two ratios NF/Re and H/d