



MACHAKOS UNIVERSITY

University Examination 2019/2020

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF BUILDING AND CIVIL ENGINEERING

THIRD YEAR FIRST SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE IN CIVIL ENGINEERING

ECV 302: HYDRAULIC I

DATE: 17/12/2019

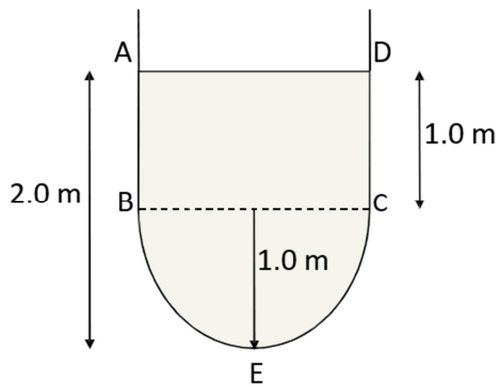
TIME: 8.30-10.30 AM

INSTRUCTIONS

Answer Question One and Any Other Two Questions

QUESTION ONE (30 MARKS)

- a) Define the term open channel flow. (2 marks)
- b) Explain the main differences between pipe flow and open channel flow (4 marks)
- c) Differentiate the following terms as used in channel flow geometry.
 - i. Wetted area and wetted perimeter. (2 marks)
 - ii. Hydraulic radius and hydraulic depth. (2 marks)
- d) A rectangular channel with a semicircular bottom of 2m diameter is used to discharge effluent from Machakos University main administration block. Calculate the discharge through the channel when the depth of flow is 2m. Take Chezy's constant $C = 70$ and the bed slope is 1 in 1000.
(7 marks)



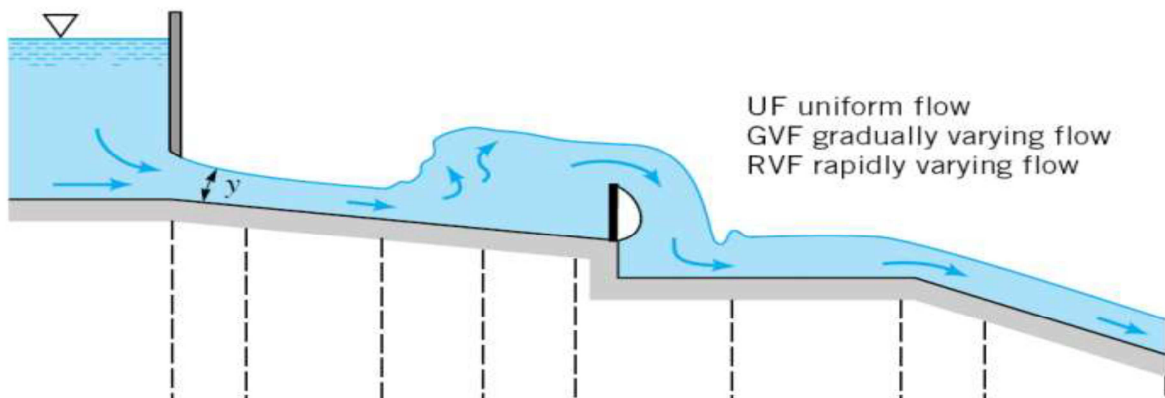
- e) Find the velocity and rate of flow of water through a rectangular channel of 5m wide and 2.5m deep when it is running full. The channel has a bed slope of 1 in 1250. Take Chezy's constant $C = 50$
(5 marks)
- f) The velocity of water flowing uniformly in a rectangular flume of base width of 600mm is $0.1\text{m}^3/\text{s}$. The depth of flow is 300mm. Calculate the following.
- Bottom slope of the flume (3 marks)
 - Conveyance 'K' of the flume (2 marks)
- g) By use of the Manning's equation, estimate the flow rate of a rectangular brick channel with the following characteristics $n = 0.016$, width is 2 m and a bed slope of 0.0012. (3 marks)

QUESTION TWO (20 MARKS)

- a) Define the term best hydraulic section (2 marks)
- b) Prove with illustrations that for a most economical section of a rectangular channel, either the depth of the flow is half the width or the hydraulic radius is half the depth of flow. (5 marks)
- c) A trapezoidal channel has side slopes of 1 horizontal to 2 vertical and the slope of the bed is 1 in 1500. The area of the section is 40m^2 . Find the dimensions of the section if it is most economical. Determine the discharge of the most economical section if $c = 50$ (6 marks)
- d) A concrete lined trapezoidal channel with uniform flow has a normal depth of 2m. The base width is 5m and the sides slopes are in the ratio of 1:2. Manning's n can be taken as 0.015 and $s_0 = 0.001$. calculate
- Discharge
 - Mean velocity
 - Reynolds number if $\mu = 1.14 \times 10^{-3} \text{NS/m}^2$ (7 marks)

QUESTION THREE (20 MARKS)

- a) Define the term specific energy (2 marks)
- b) The diagram below shows a cross-section of a flow channel. Indicate in **each section** whether the flow is Uniform Flow (UF), Gradually Varying Flow (GVF) or Rapidly Varying Flow(RVF) (2 marks)



- c) Differentiate the term alternate depth and critical depth (4 marks)
- d) With an aid of a well labeled diagram, draw a specific energy diagram (6 marks)
- e) Water in Kathonzweni irrigation scheme in Makueni County flows in a rectangular channel having a manning's roughness coefficient $n = 0.017$. The channel slope is 1 in 7000. If the bottom width is 5m and depth of flow is 1.1m, calculate the following
- Specific energy (3 marks)
 - Critical depth of flow (3 marks)

QUESTION FOUR (20 MARKS)

- a) Define the term hydraulic jump (2 marks)
- b) State the conditions necessary for the formation of a hydraulic jump (4 marks)
- c) Water flows along a 10m wide rectangular channel and through a hydraulic jump. If the flow depth just before the jump is 2.0 m, and 3.0 m after it, what is the discharge through the channel? (4 marks)

- d) A rectangular horizontal channel 2m wide, carries a flow of 4 m³/s. The depth water on the downstream side of the hydraulic jump is 1m.
- i. What is the depth upstream? (3 marks)
 - ii. What is the loss of head? (3 marks)
- e) With the aid of a diagram outline the four types of weirs (4 marks)

QUESTION FIVE (20 MARKS)

- a) Define the term gradually - varied flow (2 marks)
- b) Outline the five different types of flow profiles and state the condition in each (5 marks)
- c) A rectangular channel with a bottom width of 4.0 m and a bottom slope of 0.0008 has a discharge of 1.50 m³/sec. In a gradually varied flow in this channel, the depth at a certain location is found to be 0.30 m. assuming $n = 0.016$, determine the following,
- i. The normal depth (y_o) (3 marks)
 - ii. Critical depth (y_c). (3 marks)
 - iii. Type of GVF profile. (4 marks)