



MACHAKOS UNIVERSITY

University Examinations for 2021/2022 Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF BUILDING AND CIVIL ENGINEERING

THIRD YEAR FIRST SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (CIVIL ENGINEERING)

ECV: 302 HYDRAULIC 1

DATE: 30/8/2022

TIME: 11.00-1.00 PM

INSTRUCTIONS:

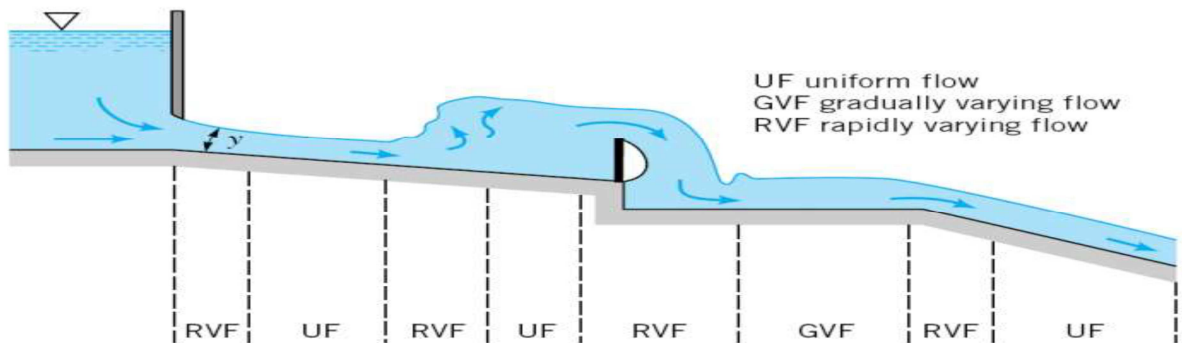
Answer question one and any other two questions

QUESTION ONE (COMPULSORY)

- a) Define the following terms.
 - i. Depth of flow and depth of flow section. (2 marks)
 - ii. Hydraulic radius and hydraulic depth. (2 marks)
- b) For a constant specific energy of 1.8, calculate the maximum discharge that may occur in a rectangular channel 5m wide. (4 marks)
- c) Derive the equations governing the most economical sections of a trapezoidal channels. (7 marks)
- d) A rectangular channel 2.50 m wide has a specific energy of 1.50 m when carrying a discharge of 6.48 m³/sec. Calculate the alternate depths and corresponding Froude numbers. Determine also the type of flow. (4 marks)
- e) Derive the Chezy's formula for determination of discharge through an open channel. (6 marks)
- f) Find the bed slope of trapezoidal channel of bed width 6 m, depth of water 3 m and side slope of 3 horizontal to 4 vertical, when the discharge through the channel is 30 m³/s. Take Chezy's constant, $C = 70$. (5 marks)

QUESTION TWO (20 MARKS)

- Discuss the general occurrence of velocity and the factors that governs its distribution in open channel flows. (5 marks)
- 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)

(3 marks)

- 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)
- What are the most efficient dimensions (the best hydraulic section) for a concrete ($n=0.012$) rectangular channel to carry 3.5 m³/s at $S_0=0.0006$? (5 marks)

QUESTION THREE (20 MARKS)

- Define the term specific energy (2 marks)
- Differentiate the term alternate depth and critical depth (2 marks)
- With an aid of a well labeled diagram, draw a specific energy diagram (6 marks)
- Discuss various methods that are used in determination of discharges in open channels (4 marks)

- e) Drainage water flows in a rectangular channel having a Manning's roughness coefficient $n = 0.018$. The channel slope is 1 in 7000. If the bottom width is 5m and depth of flow is 1.1m, calculate the following
- i. Specific energy (4 marks)
 - ii. Critical depth of flow (2 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. (2 marks)
- c) Explain the main differences between pipe flow and open channel flow. (4 marks)
- d) Water discharging into a 10-m-wide rectangular horizontal channel from a sluice gate is observed to have undergone a hydraulic jump. The flow depth and velocity before the jump are 0.8 m and 7 m/s, respectively. Determine
 - i. The flow depth and the Froude number after the jump. (4 marks)
 - ii. The head loss and the energy dissipation ratio. (3 marks)
- e) 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 head loss? (2 marks)

QUESTION FIVE (20 MARKS)

- a) Describe four types of weirs that are used for flow measurements (2 marks)
- b) A trapezoidal channel has sides slopes of 1 horizontal to 2 vertical and the slope of the bed is 1 in 1500. The area of the section is 40m². Find the dimensions of the section if it is most economical. Determine also the discharge of the most economical section if $C=50$. (6 marks)
- c) The velocity of water flowing uniformly in a rectangular flume of base width of 600mm is 0.1m³/s. The depth of flow is 300mm and Chezy's constant is 56. Calculate the following.
 - i. Bottom slope of the flume (3 marks)
 - ii. Conveyance 'K' of the flume (2 marks)
- d) 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). (2 marks)
- iii. Type of GVF profile. (2 marks)