



MACHAKOS UNIVERSITY

University Examinations for 2022/2023

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:

TIME:

INSTRUCTIONS

Answer Question One and Any Other Two Questions

QUESTION ONE (COMPULSORY) (30 MARKS)

- a) Define the terms alternate and critical depths. (2 marks)
- b) List the classifications of flows in open channels (2 marks)
- c) The specific energy for a 5m wide rectangular channel is to be 4m. if the rate of flow of water through the channel is $20\text{ m}^3/\text{s}$, determine the alternate depths of flow. (3 marks)
- d) Explain the main differences between pipe flow and open channel flow (5 marks)
- e) A rectangular channel carries a discharge of $18\text{ m}^3/\text{s}$ and the width of the channel is 6 m. Find the minimum specific energy of the flowing water. (4 marks)
- f) Derive the equations governing the most economical sections of a trapezoidal channels. (5 marks)
- g) A rectangular channel 2.50 m wide has a specific energy of 1.50 m when carrying a discharge of $6.48\text{ m}^3/\text{sec}$. Calculate the alternate depths and corresponding Froude numbers. Determine also the type of flow. (3 marks)
- h) The discharge in a rectangular channel of width 6 m with Manning's $n=0.012$ is $24\text{ m}^3/\text{s}$. If the bed slope is 1 in 200 find:
 - i. The normal depth (2 marks)
 - ii. The froude number at the normal depth (2 marks)

iii. The critical depth (2 marks)

State whether the normal flow is subcritical or supercritical.

QUESTION TWO (20 MARKS)

- a) Define the term open channel flow. (2 marks)
- b) 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)
- c) A rectangular channel 4m wide has a depth of water 1.5m. The slope of the bed of the channel is 1 in 1000 and the value of Chezy's constant $C=55$. It is desired to increase the discharge to a maximum by changing the dimensions of the section for constant area of cross-section, slope of the bed and roughness of the channel. Find the new dimensions of the channel and the increase in discharge. (7 marks)
- d) The discharge of water through a rectangular channel of width 8m, is 15m³/s when depth of flow is 1.2m. Calculate the following
- i. Specific energy of the flowing water (2 marks)
 - ii. Critical depth and critical velocity (2 marks)
 - iii. Value of minimum specific energy (2 marks)

QUESTION THREE (20 MARKS)

- a) Define the term specific energy. (2 marks)
- b) With an aid of a well labeled diagram, draw a specific energy diagram (6 marks)
- c) Derive the Chezy's formula for determination of discharge through an open channel (6 marks)
- d) 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
- a) Specific energy (4 marks)
 - b) Critical depth of flow (2 marks)

QUESTION FOUR (20 MARKS)

- a) Define the term hydraulic jump (2 marks)
- b) Discuss three industrial uses of hydraulic jumps in open flows (3 marks)
- c) 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
- The flow depth and the Froude number after the jump, (3 marks)
 - The head loss and the energy dissipation ratio, (3 marks)
- e) A sluice gate discharge water into a horizontal rectangular channel with a velocity of 6 m/s and depth of flow is 0.4m. the width of the channel is 8m. Determine whether a hydraulic jump will occur, and if so, find its height and loss of energy per kg of water. /Also determine the power lost in the hydraulic jump (5 marks)
- f) The depth of flow of water at a certain section of a rectangular channel of 2m wide is 0.3m. the discharge through the channel is 1.5m³/s. determine whether a hydraulic jump will occur and if so find its height and loss of energy. (4 marks)

QUESTION FIVE (20 MARKS)

- a) 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)
- b) Derive the equation for minimum specific energy in terms of critical depth. (3 marks)
- c) A trapezoidal channel has side slopes of 3 horizontal to 4 vertical and slope of its bed is 1 in 2000. Determine the optimum dimensions of the channel, if it is to carry water at 0.5 m³/s. Take chezy's constant 80. (5 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,
- The normal depth (y_o) (2 marks)
 - Critical depth (y_c). (2 marks)
 - Type of GVF profile. (2 marks)