



# MACHAKOS UNIVERSITY

University Examinations for 2021/2022 Academic Year

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF PHYSICAL SCIENCES

FOURTH YEAR FIRST SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE IN APPLIED PHYSICS AND TECHNOLOGY

SPH 449: COMPUTATIONAL METHODS IN PHYSICS

DATE: 25/8/2022

TIME: 2.00-4.00 PM

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## INSTRUCTIONS:

- The paper consists of **two** sections.
- Section **A** is **compulsory** (30 marks).
- Answer any **two** questions from section **B** (each 20 marks)

## SECTION A

### QUESTION ONE (30 MARKS)

- Explain what numerical methods are and state why they are necessary. (2 marks)
  - List three examples of numerical methods, other than Euler, Newton Raphson methods and Gauss Seidel method. (3 marks)
  - Explain what is meant by the term numerical computation. (3 marks)
  - Describe three main steps, in a numerical computation process. (3 marks)
  - State any **three Algorithmic** programming languages. (3 marks)
  - Distinguish between Algorithmic languages and machine assembly language. (2 marks)
  - Write the steps followed when opening a workspace in code blocks c ++. (3 marks)
  - Write down the code for your first C++ program, that prints HELLO WORLD. (3 marks)
  - Write the syntax for the following:
    - For loop
    - While loop (2 marks)
  - Write a program that can be used to ask a user to input a pin 1234 in a teller machine. (3 marks)
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- k) Write a C++ program that can be used to compute  $y = a + b - c$  for any numerical values assigned to a, b, and c (3 marks)

## SECTION B

### QUESTION TWO (20 MARKS)

- a) Describe Euler method using a diagram and show that  $y_i = y_o + \frac{dy}{dx} \Delta x$  (abbreviations retain their usual meaning) (6 marks)
- b) Use Euler's method with a step size of 0.1 to approximate  $y(0.3)$  for initial value problem  $\frac{dy}{dx} = 2x + 3y$ ,  $y(0) = 1$  (6 marks)
- c) Draw a flow diagram for the program that can be used to solve a problem using Euler method. (8 marks)

### QUESTION THREE (20 MARKS)

- a) Using a paper and a pencil, use Euler method to find value of  $y$  at  $x = 0.6$  for initial value problem  $y = \frac{1}{8} (x^2 - 4x)$ ,  $y(2) = 0$ ,  $\Delta x = 0.2$  (8 marks)
- b) Write down the algorithm that can be used to execute the problem in 3 a) above (6 marks)
- c) Write a C++ program that can be used to solve an initial value problem using the Euler method. (6 marks)

### QUESTION FOUR (20 MARKS)

- a) Define the Gauss Seidel method (2 marks)
- b) Using a paper and a pencil, solve the three linear equations below by Gauss Seidel method. Tabulate the result in a table.  
 $4x+2y+2z=10$ ,  $3x+5y+2z=15$ ,  $2x+y+4z = 8$  (12 marks)
- c) Write a C++ program that can be used to solve the problem in 4 b) above (6 marks)

### QUESTION FIVE (20 MARKS)

- a) Define the Newton Raphson method (2 marks)
- b) Express  $f(x) = 2x^2 + 8$  in the form  $x_{i+1} = x_i - \frac{f(x_i)}{f'(x_i)}$  (5 marks)

- c) Solve 5 b) using a paper and a pencil by Newton Raphson method and tabulate your result.  
Take initial estimate as  $x = 2$  (7 marks)
- d) Write a C++ program that can be used to solve the problem in 5 c) (6 marks)