# MURANG'A UNIVERSITY OF TECHNOLOGY

## SCHOOL OF COMPUTING AND INFORMATION TECHNOLOGY

### DEPARTMENT OF COMPUTER SCIENCE

UNIVERSITY ORDINARY EXAMINATION

2023/2024 ACADEMIC YEAR

**FOURTH** YEAR **FIRST** SEMESTER EXAMINATION FOR BACHELOR OF SCIENCE IN COMPUTER SCIENCE/MATHEMATICS AND COMPUTER SCEINCE/EDUCATION SCEINCE

SCS 403 – SCIENTIFIC COMPUTING

DURATION: 2 HOURS

**INSTRUCTIONS TO CANDIDATES:**

1. Answer QUESTION ONE and any other TWO Questions.

2. Mobile phones are not allowed in the Exam room.

3. You are not allowed to write on this examination question paper.

**SECTION A – ANSWER ALL QUESTIONS IN THIS SECTION**

**QUESTION ONE (30MARKS)**

a. Define the following high-performance computing concepts:                 (4marks)
  - i.      Cloud computing
  - ii.     Load sharing and balancing
  - iii.    Grid computing
  - iv.     Cluster computing

b. Give a brief definition of the following mathematical foundations for scientific computing terms:                                                                                    (5marks)
  - i.      Set theory
  - ii.     Mathematical proof
  - iii.    Mathematical induction
  - iv.     Graph theory
  - v.      Relations

c. Explain two advantages and two disadvantages of MATLAB.                 (4marks)

d. Using suitable examples give the syntax of the following MATLAB control flows.
  - i.   If statement
  - ii.  "for … end" loop                                                                             (4marks)

e. If C and F are Celsius and Fahrenheit temperatures respectively, the formular for conversion from Celsius to Fahrenheit is F=9C/5+32
  - i.   Write a script which will ask you for the Celsius temperature and display the equivalent Fahrenheit one with some form of comment. E.g. *The Fahrenheit temperature is….*
                                                                                                             (2marks)
  - ii.  Change the script to use vectors and array operations to compute and display the Fahrenheit equivalent of Celsius temperatures ranging from $20^o$ to $30^o$ in steps of $1^o$, in two columns with a heading e.g.

| Celsius | Fahrenheit |
|---------|------------|
| 20.00   | 68.00      |
| 21.00   | 69.00      |
| ……      | ……         |
| 30.00   | 86.00      |

                                                                                                             (2 marks)

f. State **FOUR** features of MATLAB                                                         (4 marks)

g. Using MATLAB code, explain two types of concatenation supported by MATLAB.
                                                                                                             (2 marks)

h. Let $A = \begin{pmatrix} 6 & 4 & 3 \\ 7 & 3 & 4 \\ 9 & 6 & 5 \end{pmatrix}$

Using the column vector operator (:) create a column vector operator that contains all row of A

**SECTION B – ANSWER ANY TWO QUESTIONS IN THIS SECTION**

**QUESTION TWO (20 MARKS)**

a.  .
  i.  Using the algorithm based on Gaussian elimination, compute the inverse of the matrix.

$$A = \begin{bmatrix} 1 & 1 & 0 \\ 0 & 1 & 2 \\ -2 & 1 & -1 \end{bmatrix}$$  (4marks)

b.  Using the results from part (i), solve the matrix equation:

$$A = \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 2 \\ 3 \\ -2 \end{bmatrix}$$  (2marks)

c.  With the help of MATLAB code, explain TWO special array functions in MATLAB.
  (4marks)

d.  In the context of scientific computational models, give a brief description of the following concepts:  (6marks)
  i.  Simulation
  ii.  Parameter comparison
  iii.  Model comparison
  iv.  Inference

e.  .
  i.  Develop a structure plan for the solution of two simultaneous linear equations (i.e. equations of two straight line). Your algorithm should be able to handle all possible situations, viz. lines which are intersecting, parallel, or coincident.  (3marks)
  ii.  Write a program to implement your algorithm.  (3marks)

**QUESTION THREE (20 MARKS)**

a.  Differentiate MATLAB scripts and functions.  (6marks)

b.  The electricity accounts of residence in Kenya are calculated as follow:
  i.  If 500 units or less are used, the cost is 2 cents per unit;
  ii.  If more than 500, but not more than 1000 units are used, the cost is Ksh100 for the first 500 units, and then 50 cents for every unit in excess of 500.
  iii.  If more than 1000 units are used the cost of Ksh.350 for the first 1000 units plus Ksh.10 for every unit in excess of 1000
  iv.  In addition, a basic service fee of KSh.50 is charged, not matter how much electricity is used.

  Write MATLAB program which enters the following five consumptions into a vector and uses a loop to calculate and display the total charge for each one: 200, 700, 1000, 1500. (6marks)

c.  An important aspect of scientific programming is the understanding of errors made during computation of solution. Explain an overview of errors made in scientific programming.
  (6marks)

d.  How many times will the display in the following commands be executed?  (2marks)

```
        x = 3
        While (x<8)
            disp("Am not done yet?)
            x = x + 2.5;
        end;
```

**QUESTION FOUR (20 MARKS)**

a. Discuss Fynn's classification of computer architecture. (8marks)
b. Murang'a University is in the process of putting up a data science centre collecting and analyzing amount of data it has been collecting from students and its staff members. You have been contracted to explain why parallel computing will be the best approach to take. Explain to them four reasons why they should use parallel computing. (8marks)
c. The spiral of Archimedes (see figure below) may be represented in polar co-ordinate by the equation:

$$R = a\theta$$

Where *a* is some constant. Write MATLAB command-line statements to draw the spiral for some values of *a*. (4marks)