2920/106
COMPUTATIONAL MATHEMATICS
November 2021
Time: 3 hours

THE KENYA NATIONAL EXAMINATIONS COUNCIL

DIPLOMA IN INFORMATION COMMUNICATION TECHNOLOGY

MODULE 1

COMPUTATIONAL MATHEMATICS

3 hours

INSTRUCTIONS TO CANDIDATES

*This paper consists of **EIGHT** questions.*
*Answer any **FIVE** of the **EIGHT** questions in the answer booklet provided.*
Candidates should answer the questions in English.

This paper consists of 5 printed pages.

Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.

nominal
ordinal
interval
ratio

1. (a) Outline **four** basis of classifying statistical data. (4 marks)

(b) Describe each of the following classes of binary codes:

(i) reflective; when the code results is complementing

(ii) sequential; where ... subsequent no rep differ by only one digit

(iii) alphanumeric. follows the alphabetic order (6 marks)

(c) (i) Reduce each of the following equations to quadratic equations:

(I) $\frac{x+2}{5} = \frac{7}{x}$

(II) $x^4 - 7x^2 + 12 = 0$ (4 marks)

(ii) Use factorization method to determine the value of x for each of the reduced equations in (i). (6 marks)

2. (a) Outline **two** types of classification that could be applied on statistical data. (2 marks)

(b) A bag consists of 3 red marbles, 5 blue marbles, and 8 green marbles. Two marbles are drawn at random with replacement.

(i) Represent the information using a tree diagram.

(ii) Hence; determine the probability of drawing;

(I) 1 red and 1 blue marbles;

(II) at least a green marble. (6 marks)

(c) With the aid of an illustration, distinguish between each of the following:

(i) diagonal matrix and a scalar matrix.

(i) column matrix and a row matrix; (8 marks)

(d) Given matrix $\mathbf{P} = \begin{bmatrix} 3 & 6 & 2 \\ 4 & 5 & 1 \\ 7 & 0 & 3 \end{bmatrix}$, and $\mathbf{Q} = \begin{bmatrix} \frac{-3}{11} & \frac{18}{55} & \frac{4}{55} \\ \frac{1}{11} & \frac{1}{11} & \frac{-1}{11} \\ \frac{7}{11} & \frac{-42}{55} & \frac{9}{55} \end{bmatrix}$.

(i) Determine PQ; (3 marks)

(ii) State the relationship between matrix **P** and matrix **Q**. (1 mark)

3. (a) Explain each of the following events as applied in probability:

(i) mutually exclusive events;

(ii) equally likely events. (4 marks)

(b) Convert each of the numbers to the base indicated and show your workings:

(i) 411_8 to hexadecimal;

(ii) $10E_{16}$ to decimal;

(iii) 45_{10} to binary;

(iv) 1010011_2 to octal. (8 marks)

(c) The two sets M and N such that $M = \{a, c\}$ *and* $N = \{a, d, c, f\}$, determine each of following set operations:

(i) $M \times N$;

(ii) M^2. (4 marks)

(d) A committee of 5 is to be selected from 5 women and 3 men. Determine the number of ways a committee of 5 can be selected such that at least 3 of them are women. (4 marks)

4. (a) (i) Define the term *Kurtosis* as used in statistics. (1 mark)

(ii) Outline **three** types of kurtosis. (3 marks)

(b) Table 1 shows results of a study carried out to determine preference of soap perfume among college students. Use it to answer the questions that follow.

Preference	Frequency
Yes	155
No	451
No responds	141

Table 1

Present this information using each of the following charts:

(i) bar chart;

(ii) pie chart. (6 marks)

(c) Peter measured the length of the field and recorded 58.0 metres. The actual length of the field was 57.2 metres. Determine each of the following errors in the measurement:

(i) absolute error;

(ii) percentage error. (4 marks)

(d) Derive the iterative algebraic formula for the equation $x^2 - 3x + 1 = 0$. (6 marks)

5. (a) Describe **two** primary types of *spatial data models*: (4 marks)

(b) Write each of the following English statements using predicate logic.

(i) Some cows are brown;

(ii) All crows are black;

(iii) All that glitters is not gold. (6 marks)

(c) Use the graphical method to solve the following set of linear simultaneous equations: Use $-5 \leq x \leq 1$.

$$3x + 2y = 0$$
$$4x + y + 11 = 0$$

(4 mark)

(d) Use the iterative algebraic formulae $x_{n+1} = 1 + \frac{11}{x_{n-3}}$ to compute the solution of the equation $x^2 - 4x - 8 = 0$ given the initial value $x_1 = -2$ and give your answer to 3 decimal places. (6 marks)

6. (a) Explain each of the events as applied in probability:

(i) independent events;

(ii) compound events;

(iii) mutually exclusive events. (6 marks)

(b) (i) Estimate by calculation the absolute error for $f(x, y) = x^2y^2 + x + y$ at the point $(-1, 2)$ if the error in $x = 0.1$ and the error in $y = 0.025$. (6 marks)

(ii) Compare the estimated error with the exact value of the error in (i) and comment. (2 marks)

(c) Draw a truth table for the logic curcuit in Figure 1. (6 marks)

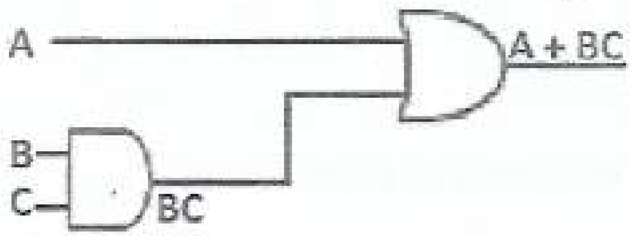

Figure 1

7. (a) (i) Outline **four** properties of arithmetic mean as a measure of central tendency. (4 marks)

(ii) Describe the *median* as a measure of central tendency. (2 marks)

(b) Explain **three** differences between *discrete random variable* and *continuous random variable*. (6 marks)

(c) Determine the coefficient of the term x^4y^{16} in the expression$(2x - y^2)^{12}$. (4 marks)

(d) Compute a power series representation for the function $g(x)$ and determine its interval of convergence.

$g(x) = \frac{1}{1+x^3}$ (4 marks)

8. (a) (i) Outline **two** assumptions of linear extrapolation. (2 marks)

(ii) Table 1 shows the rate of growth of bacteria at various temperatures observed in a laboratory. Use it to answer the question that follows.

Temp (°F)	20	30	40	50	60	70	80
Rate mg/min	0.21	0.3	0.37	0.45	0.52	0.57	0.62

Table 1

Use the interpolation method to determine the rate of growth at 36^0 F. (4 marks)

(b) With the aid of a diagram in each case, explain each of the following logic gates:

(i) NAND gate;

(ii) NOR gate. (6 marks)

(c) Draw a logic gate circuit that represents the algebraic function F= AB + CD. (4 marks)

(d) Determine the power series representation of $f(x) = 2x^2 \frac{1}{1+x^3}$ and its interval of convergence. (4 marks)

THIS IS THE LAST PRINTED PAGE.