2920/106
COMPUTATIONAL MATHEMATICS
November 2022
Time: 3 hours

THE KENYA NATIONAL EXAMINATIONS COUNCIL

DIPLOMA IN INFORMATION COMMUNICATION TECHNOLOGY

MODULE I

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.

Turn over

1. (a) The following acronyms are used in binary number system:

BCD; EBCDIC; and *ASCII.*

(i) Write each of the acronyms in full. (3 marks)

(ii) Define each of the terms. (3 marks)

(b) Describe each of the following methods of collecting statistical data:

(i) observation;

(ii) record inspection. (4 marks)

(c) Convert each of the following numbers to their equivalent number systems as indicated:

(i) 3276_8 to hexadecimal;

(ii) $C9D_{16}$ to octal;

(iii) 7695_{10} to binary. (6 marks)

(d) A tea factory intends to form a committee of five persons comprising of 3 men. The committee is to be selected from 7 men and 6 women. Determine the number of ways in which this committee can be selected. (4 marks)

2. (a) Define each of the following terms as used in statistics:

(i) skewness;

(ii) kurtosis. (2 marks)

(b) The relationship between x and y is of the form $y = -x^2 - 4$:

(i) plot the graph for the relationship; (4 marks)

(ii) determine graphically the turning point of the curve drawn in (i); (1 mark)

(iii) determine the x and y intercepts for the curve. (2 marks)

(c) Use *two's complement* of 7 bits to perform the arithmetic operation 67- 42. (4 marks)

(d) Table 1 shows the results of a survey to detect fraud through the use of first digit in the business records. Use it to answer the questions that follow.

First Digit	1	2	3	4	5	6	7	8	9
Probability	0.301	0.176	0.125	0.097	0.079	0.067	0.058	0.051	0.046

Table 1

A document is picked at random. Determine the probability of detecting a fraud if the first digit of the document is:

(i) exactly 3;

(ii) 1 or 6;

(iii) greater than 6. (7 marks)

3. (a) (i) Outline **three** advantages of using electronic questionnaires to collect statistical data. (3 marks)

(ii) State the difference between *primary data* and *secondary data* in terms of each of the following aspects:

(I) their meaning;

(II) their source. (4 marks)

(b) Describe each of the following logic gates using two inputs as applied in digital logics:

(i) XOR gate;

(ii) NAND gate;

(iii) NOR gate. (6 marks)

(c) (i) Represent the Boolean algebra $\mathbf{AB} \oplus \overline{(\mathbf{A} + \mathbf{B})}$ using logic gates. (5 marks)

(ii) Draw the truth table for the algebraic expression of 2-input logic gates in (i). (2 marks

4. (a) Define each of the following terms as applied in mathematics:

(i) permutation; (2 marks)

(ii) combination. (2 marks)

(b) A cubic polynomial function is given by $f(x = x^4 + 3x^2 - x - 5)$. Using the Newton Rahpton iteration method, determine the root of the equation rounded off to 6 decimal places. Take $x_0 = -0.5$. (6 marks)

(c) Table 2 is a contingency table showing the probabilities of women getting married in a particular constituency depending on their age and number of children:

Age	Number of Children		
	0	1 or 2	3 or More
Under 20	0.02	0.14	0.08
20–29	0.07	0.37	0.11
30 and above	0.10	0.10	0.01

Table 2

A woman was selected at random, determine the probability of getting married if she:

(i) was in her twenties;

(ii) was 20 or older;

(iii) had no children;

(iv) was in her twenties and had at least three children. (4 marks)

(d) Using graphical method, solve the following quadratic equation;

$y = -x^2 + 6x + 7$ (6 marks)

5. (a) Outline **two** properties of the *mean* as a measure of central tendency. (2 marks)

(b) State whether each of the following sets is a *finite* or *infinite* set, justifying your answer:

(i) multiples of 3;

(ii) factors of 45. (6 marks)

(c) Distinguish between each of the following pairs of terms as used in statistics:

(i) linear interpolation and linear extrapolation; (4 marks)

(ii) relative error and absolute error. (4 marks)

(d) A physical quantity X is given by $X = \frac{a^2b^3}{\sqrt{c}}$ and the percentage errors in a, b and c are 4%, 2% and 1% respectively. Determine the percentage error in X. (4 marks)

6. (a) Describe each of the following types of data models as used in spatial modelling:

(i) vector data model;

(ii) rasta data model. (4 marks)

(b) Tables 3 and 4 show the number of different books for various grades and their respective prices as bought by a school. Use them to answer to answer the questions that follow.

	Grade 1	Grade 2	Grade 3
Maths	20	35	15
English	15	42	24
Kiswahili	18	38	22

Table 3

Price Ksh	
Maths	150
English	200
Kiswahili	250

Table 4

(i) Represent this information in matrix form; (2 marks)

(ii) Determine the total cost of all the books using matrix method. (4 marks)

(c) Use determinant matrix method to solve the following simultaneous equations:

$$2x + 3y - z = 15$$
$$4x - 3y - z = 19$$
$$x - 3y + 3z = -4$$

(10 marks)

7. (a) (i) State the binomial theorem as used in statistics. (2 marks)

(ii) Using Pascal's triangle, determine the term with the 5^{th} power of the expression $(2x - 3y)^5$ in the ascending powers of y. (6 marks)

(b) The data in table 5 shows the distribution of marks of a national exam in a school. Use it to answer the questions that follow.

Marks	410 - 419	420 - 429	430 - 439	440 - 449	450 - 459	460 - 469	470 - 479
Frequency	14	20	42	52	45	18	7

Table 5

Calculate the following measures about the marks:

(i) the mean;

(ii) the standard deviation;

(iii) upper quartile. (8 marks)

(c) David bought 20 DVDs and 33 CDs at a total cost of KShs 490. Ellie bought 32 DVDs and 25 CDs in the same shop at a total cost of KShs 506.

(i) Represent the information as a system of linear equations. (1 mark)

(ii) Determine the cost of one DVD and one CD respectively. (3 marks)

8. (a) Outline the meaning of each of the following operations as used in sets:

(i) $A \cup B$;

(ii) $B \subseteq A$;

(iii) $|P|S = 5$;

(iv) $x \in A$. (4 marks)

(b) Distinguish between a *diagonal* matrix and a *triangular* matrix. (4 marks)

(c) Given that matrix $A = \begin{bmatrix} 2 & 5 & 7 \\ 2 & -1 & 0 \\ 3 & 4 & 8 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & 4 & 9 \\ 3 & -2 & 4 \\ -5 & 4 & 8 \end{bmatrix}$ show that:

(i) $(A + B)^T = A^T + B^T$; (3 marks)

(ii) $AB \neq BA$. (3 marks)

(d) The following data shows the height in centimetres of 30 students in a college. Use it to answer the questions that follow.

142	163	169	132	139	140	152	168	139	150
161	132	162	172	146	152	150	132	157	133
141	170	156	155	169	138	142	160	164	168

(i) Arrange the data as a grouped frequency distribution with a class interval of 10 centimetres taking the lower-class boundary as 130. (2 marks)

(ii) Draw a histogram to represent the frequency distribution in (i). (4 marks)

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