2920/106
COMPUTATIONAL MATHEMATICS
November 2016
Time: 3 hours

THE KENYA NATIONAL EXAMINATIONS COUNCIL

DIPLOMA IN INFORMATION COMMUNICATION TECHNOLOGY

MODULE I

COMPUTATIONAL MATHEMATICS

3 hours

INSTRUCTIONS TO THE CANDIDATE
You should have a scientific calculator for this examination.
*This paper consists of **EIGHT** questions.*
*Answer any **FIVE** of the **EIGHT** questions in the answer booklet provided.*
All questions carry equal marks.
Candidates should answer the questions in English.

This paper consists of 6 printed pages.
Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.

1. (a) Define each of the following terms as used in mathematics:

(i) interpolation;

(ii) extrapolation;

(iii) mode. (6 marks)

(b) Use the matrix method to solve the following system of simultaneous equations:

$$4x - 3y = 18$$
$$2y - x = 1$$
(4 marks)

(c) Using the decimal number 3.14159265, perform the following instructions:

(i) truncate the number to 4 significant figures;

(ii) round off the number to 4 decimal places. (4 marks)

(d) (i) Explain the term *infinite difference table* as used in numerical analysis. (2 marks)

(ii) Table 1 shows values for x_i and y_i. Use it to answer the question that follows.

x_i	1	2	3	4	5	6
y_i	9	25	71	162	313	539

Table 1

Using the Newton forward interpolation method, construct the forward difference table. (4 marks)

2. (a) Explain **two** advantages of the *median* over the *arithmetic mean* as statistical measures. (4 marks)

(b) Explain **three** assumptions in interpolation. (6 marks)

(c) Distinguish between *permutation* and *combination* as used in mathematics. (2 marks)

(d) (i) Figure 1 shows three straight line graphs. Identify the line graph that corresponds to the following equations: (3 marks)

I. $y = x - \frac{1}{2}$;

II. $y = \frac{1}{4}x + 1\frac{1}{2}$;

III. $y = -x + 3$.

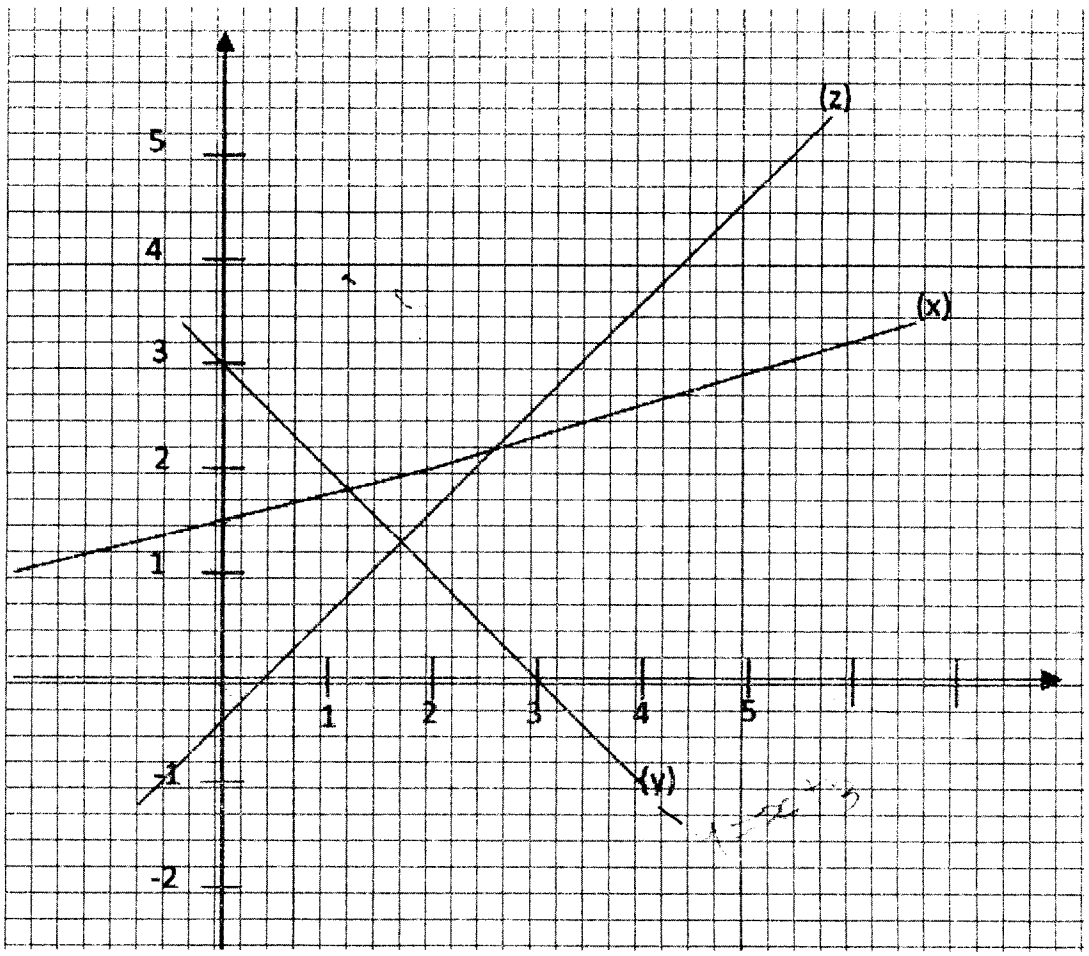

Figure 1

(ii) Using the Gaussian elimination method, solve the following simultaneous equations. (5 marks)

$$z - 3x - 2y = 6$$
$$2z - 4x + 2y = 18$$
$$-3z + 8x + 9y = -9$$

3. (a) Define each of the following types of measures as used in statistics:

(i) absolute;

(ii) relative. (4 marks)

(b) Describe **three** ways in which statistical data can be classified. (6 marks)

(c) Solve each of the following:

(i) using 2's complement, subtract 37_{10} from 52_{10};

(ii) convert the binary number 10101.11_2 to its octal equivalent;

(iii) convert 1359_{10} to its octal equivalent;

(iv) convert $6AD_{16}$ to its decimal equivalent. (8 marks)

(d) A line passes through the points (0, 3) and (9, 6). Derive the equation of the line. (2 marks)

4. (a) Define each of the following terms as used in matrices:

(i) identity matrix;

(ii) singular matrix. (4 marks)

(b) The following are examples of the probability of an event occurring. Classify them as *dependent, mutually exclusive* or *independent*. (4 marks)

(i) Drawing a red ball when a ball is drawn at random from a bag that contains 4 red and 5 green balls with replacement;

(ii) Selecting a male at random from a group of 15 males and 20 females;

(iii) Winning a prize in a raffle by buying 5 tickets when there are 6 prizes and a total of 200 tickets are sold;

(iv) A couple giving birth to a baby girl as their second born if their first born is a boy.

(c) Given two input binary signals: A=100101 and B=110110, use truth tables to determine the output C when applied to each of the following gates:

(i) OR;

(ii) NAND;

(iii) XNOR. (6 marks)

(d) Show that: ${}^{2n}C_2 = 2 \times {}^{n}C_2 + n^2$. (6 marks)

5. (a) Use a mathematical notation to state the *binomial theorem*. (2 marks)

(b) With the aid of a diagram in each case, differentiate between *kurtosis* and *skewness* as used in statistics. (6 marks)

(c) Use an illustration to describe the code formats of each of the following computer coding systems:

(i) ASCII;

(ii) EBCDIC. (6 marks)

(d) A football team scores an average of 3 goals per match in 45 matches. Assuming a Poisson distribution, determine in how many matches they would expect to score each of the following :

(i) 4 goals;

(ii) less than 2 goals. (6 marks)

6. (a) Explain each of the following terms as used in statistics:

(i) spatial modelling;

(ii) logical models;

(iii) symbolic modelling. (6 marks)

(b) Given that Matrix Q $= \begin{bmatrix} 2 & 8 & 2 \\ 1 & 2 & -2 \\ 3 & 4 & -6 \end{bmatrix}$, determine each of the following:

(i) 3Q; (2 marks)

(ii) $3Q^{-1}$ using the cofactor method (8 marks)

(c) Figure 2 shows a certain logic gate. Use it to answer the questions that follow.

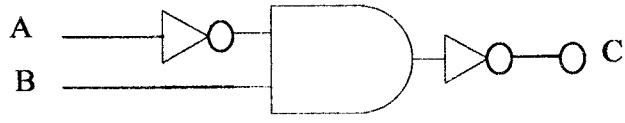

Figure 2

(i) write the Boolean equation for the output C;

(ii) determine the value of C when A=1 and B =0. (4 marks)

7. (a) Define the term *pseudo code* as used in modelling. (2 marks)

(b) (i) Plot the graph of $y = 2x^2 - 5x - 4$ for values of x ranging from -2 to 4 (4 marks)

(ii) Table 1 shows the air resistance R(r) on a vehicle when it is moving at the speed of S (m/s). Represent this data on a graph. (4 marks)

S(m/s)	0	5	10	15	20	25	30
R(r)	0	23	58	82	121	162	209

Table 1

(c) With the aid of a Venn diagram in each case, describe the following as used in set theory:

(i) $A \cup B$;

(ii) $A \cap B$. (4 marks)

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

Evaluate whether each of the following matrix operations is possible giving a reason for your answer.

I. (AB) C;

II. BC;

III. (B + C)A. (6 marks)

8. (a) Describe each of the following models as used in statistical data representation:

(i) histograms;

(ii) frequency polygons. (4 marks)

(b) The probability of three events occurring are $\frac{1}{8}$ for event X, $\frac{1}{5}$ for event Y and $\frac{2}{7}$ for event Z. Determine the probability of each of the following:

(i) event X and Y occurring but not event Z;

(ii) event Y occurring but not event X and not event Z ;

(iii) event X or event Y happening but not event Z. (7 marks)

(c) A certain examination carries a total of 10 questions and the student is required to answer 7 questions only. The paper is divided into Section A; comprising the first five questions and Section B; comprising the last five questions. Determine the number of ways the student can answer the examination:

(i) If the student must answer 3 questions from the Section A and four questions from the Section B; (4 marks)

(ii) If at least three questions are selected from the Section A. (5 marks)

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