2920/106
COMPUTATIONAL MATHEMATICS
November 2010
Time: 3 hours

THE KENYA NATIONAL EXAMINATIONS COUNCIL

DIPLOMA IN INFORMATION COMMUNICATION TECHNOLOGY

MODULE I

COMPUTATIONAL MATHEMATICS

3 hours

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:

  Answer booklet;

  Scientific calculator.

Answer any **FIVE** *of the following* **EIGHT** *questions in this paper.*

All questions carry equal marks.

This paper consists of 7 printed papers.

**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)   (i)   Explain the term *histogram* as used in data representation.   (2 marks)

            (ii)   The following data represents marks for 16 students in a mathematics
                   test:

                   81 81 94 78 84 90 96 90 86 82 80 85 89 75 78 81

                   Prepare a frequency distribution table to represent the data using a
                   class interval of five starting with 71.   (3 marks)

      (b)   Table 1 shows the details of resistors available in a certain manufacturing
             company. Use it to answer the question that follows.

Range	Frequency
150 – 159	2
160 – 164	5
165 – 169	8
170 – 174	12
175 – 179	5
180 – 184	7
185 – 189	6

Table 1

             Construct an ogive curve to represent the data.   (4 marks)

      (c)   (i)   Distinguish between *mode* and *variance* as used in statistics.
                                                                                        (2 marks)

            (ii)   Table 2 shows the number of telephone calls received daily in a certain
                   school for a period of 200 days. Use it to answer the question that
                   follows.

No. of calls	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49
Frequency	5	20	24	43	54	35	14	5

Table 2

                   Determine the mean number of the telephone calls received.
                                                                                        (3 marks)

      (d)   Table 3 shows prices of items sold in Kampuni shop. Use it to answer the
             question that follows.

Price of item (Ksh)	Frequency
10.5 – 20.4	15
20.5 – 30.4	2
30.5 – 40.4	19
40.5 – 50.4	10
50.5 – 60.4	14

Table 3

             Calculate the standard deviation for the data.   (6 marks)

2. (a)   Describe the term *intequartile range*.   (2 marks)

    (b)   Table 4 shows scores obtained by 50 students in an examination. Use it to
          answer the question that follows.

Mark	No of students
1 - 10	1
11 – 20	14
21 – 30	20
31 – 40	10
41 - 50	5

Table 4

          Determine the median mark.   (3 marks)

    (c)   (i)   State **one** advantage and **one** disadvantage of one's complement (IC).
                                                                                      (2 marks)

          (ii) Convert $469E3_{16}$ to its binary equivalent.   (4 marks)

    (d)   (i)   Describe each of the following gates as used in logic circuits:

                I.   NAND;

                II.   NOR.
                                                                                      (4 marks)

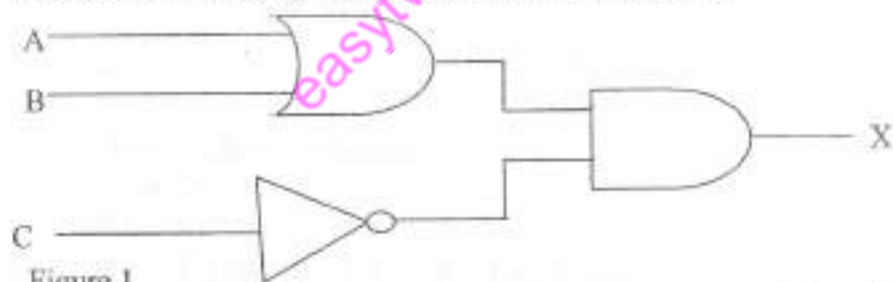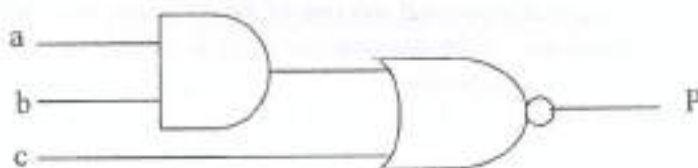   (ii) Construct a truth table for the circuit shown in figure 1.

                Figure 1
                                                                                      (5 marks)

3. (a)   (i)   Given that a = 1, b = 1 and c = 0, determine the output P for the inputs
                a, b and c in following circuit.

                                                                                      (2 marks)

          (ii) Derive a truth table for the following boolean expression.

                (NOT A) AND B   (2 marks)

(b)   (i)   Solve the following pairs of simultaneous equation using substitution method.

$$4x + 2y = 10$$
$$3x - 5y = 1$$

(3 marks)

      (ii)   Solve the following simultaneous equations using matrices.

$$4x + y - 2z = 0$$
$$2x - 3y + 3z = 9$$
$$-6x - 2y + z = 0$$

(7 marks)

(c)   (i)   Explain the following terms as used in algebra:

I.   diagonal matrix;

II.   identity matrix.

(2 marks)

      (ii)   Given that:

$$A = \begin{pmatrix} 2 & 1 & 0 \\ 3 & -1 & 4 \end{pmatrix} \text{ and } B = \begin{pmatrix} 6 & -3 \\ 0 & 4 \\ 4 & 0 \end{pmatrix}$$

Find $(AB)^{-1}$

(4 marks)

4.   (a)   (i)   Solve $3x^2 - 10x + 4 = 0$ using the formula method.   (4 marks)

      (ii)   Given that $A = \begin{pmatrix} 2 & -1 & 2 \\ 1 & 0 & 3 \\ 3 & -2 & -5 \end{pmatrix}$ and $B = \begin{pmatrix} 3 & -6 & -3 \\ 7 & -14 & -7 \\ -1 & 2 & 1 \end{pmatrix}$

Show that $AB \neq O$

(4 marks)

(b)   (i)   A factory produces a product using 4 different components. The product is discarded if any one of the components is defective. The probabilities of the components being defective are 0.04, 0.03, 0.05 and 0.04 respectively.
Determine the probability that a product picked at random will not be discarded.   (3 marks)

      (ii)   Explain the following terms as used in probability:

I.   mutual exclusion;

II.   independent events.

(4 marks)

(c) Table 5 shows details of staff at Kesho college of computing. Use it to answer the questions that follow.

Gender	Non-Teaching staff	Teaching staff
Male	5	5
Female	21	9

Table 5

Find the probability of choosing:

(i) a female staff;   (2 marks)

(ii) a female staff given that she is a teacher.   (3 marks)

5. (a) A box contains 6 white and 4 red marbles. If 2 marbles are picked one after the other from the box without replacement:

(i) draw a probability tree diagram to show all the possible outcomes;
                                                                   (4 marks)

(ii) determine the probability of picking at least one red marble.
                                                                   (2 marks)

(b) The height (h) in metres of a particular object projected from the ground with respect to time (t) is $h(t) = 50t - 4.9t^2$.

Find:

(i) the height when t = 3 seconds.   (2 marks)

(ii) determine the time when the object will hit the ground.   (2 marks)

(c) (i) Define each of the following terms as used in functions:

I. domain;

II. range.

                                                                   (4 marks)

(ii) The electric power (P) delivered by a battery as a function of resistance R is given by the formula.

$$P = \frac{100R}{(0.50 + R)^2}$$

Plot the power as a function of the resistance for values $0 \leq R \leq 4$.
                                                                   (6 marks)

6. (a) Describe the following errors giving an appropriate example in each case:

(i) rounding;

(ii) truncation;

(iii) percentage.

                                                                   (6 marks)

(b) Expand $(x^2 + 3)^6$ up to the fourth term.   (5 marks)

(c)   (i)   Describe the term *binomial coefficient*.   (2 marks)

      (ii)   11 players and 3 reserve players are to be chosen from a team of 23 players to participate in a football match. Determine the number of ways in which the players can be chosen.   (3 marks)

(d)   A box contains 5 black and 4 yellow marbles. In how many ways can 4 marbles be drawn so as to include 2 yellow marbles?   (4 marks)

7.   (a)   An ICT class in Macho College consists of 14 male students and 17 female students. Four of the students from the class are to be selected for an academic trip to Mombasa.

      (i)   In how many ways could the 4 students be selected from the class?   (2 marks)

      (ii)   Determine he number of ways in which 2 male and 2 female students could be selected from the class for the trip.   (4 marks)

(b)   Given f(x) such that $f(1.2) = 2.847$ and $f(2.5) = 0.039$, determine the following using linear interpolation.

      (i) $f(1.5)$

      (ii) $f(2.6)$

                                                            (6 marks)

(c)   Describe each of the following binary codes:

      (i)   excess-3;

      (ii)   sequential.   (4 marks)

(d)   Convert the gray coded number 11011011 to its binary equivalent.   (4 marks)

8.   (a)   Describe a *system* as used in modeling.   (2 marks)

(b)   Define the following terms as used in numerical analysis:

      (i)   inflection point;

      (ii)   root.   (4 marks)

(c)   Distinguish between *deterministic* and *probabilistic* models as used in mathematics.   (4 marks)

(b) Table 6 shows the values of i and its corresponding values for x_i and f_i. Use it to answer the questions that follow.

i	0	1	2	3	4	5
x_i	0	1	2	3	4	5
f_i	1	2	4	8	16	32

Table 6

(i) Generate the Newton-Gregory forward difference table.

(3 marks)

(ii) Estimate f(4.12)

(7 marks)