SCAN

Name: _____ Index Number _____ /

2920/106
COMPUTATIONAL MATHEMATICS
July 2015
Time: 3 hours

Candidate's Signature_____

Date: _____

THE KENYA NATIONAL EXAMINATIONS COUNCIL

DIPLOMA IN INFORMATION COMMUNICATION TECHNOLOGY

MODULE I

COMPUTATIONAL MATHEMATICS

3 hours

INSTRUCTIONS TO CANDIDATES

Write your name and index number in the spaces provided above.
Sign and write the date of examination in the spaces provided above.
You should have a scientific calculator for this examination.
Answer any FIVE of the following EIGHT questions.
Candidates should answer all questions in English.

For Examiner's Use Only

Question	1	2	3	4	5	6	7	8	Total Score
Candidate's Score									

This paper consists of 18 printed pages

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

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Turn over

1. (a) (i) Outline **two** assumptions in linear interpolation.   (2 marks)

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        (ii) Define the term *finite difference table* as applied in numerical analysis.   (2 marks)

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    (b) Differentiate between the terms *iteration* and *interpolation* as methods of mathematical estimation.   (4 marks)

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    (c) (i) Define the term *model* as used in science and business.   (2 marks)

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        (ii) Justify the need for the use of models in science and business.   (2 marks)

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(d)   The data in Table 1 represents the number of students with indiscipline cases at Jitahidi High School in the year 2014. Use it to answer the questions that follow.

	Term 1	Term 2	Term 3
Form 1	10	16	20
Form 2	23	35	30
Form 3	30	25	40
Form 4	16	24	10

Table 1

Represent the data using each of the following:

(i)   Grouped bar chart;   (3 marks)

(ii)   Percentage component bar chart.   (5 marks)

2.	(a)	State the general *binomial theorem* involving the sum of two values a and b expressed in ascending and descending powers of a. (4 marks)

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(b)	Given the linear function defined by the general equation:

$$y = ax + b$$

Explain the numeric constants a and b in the above equation. (4 marks)

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(c)	Table 2 shows a relative frequency distribution of the age in years of Jaribu Bank Limited staff. Use it to answer the questions that follow.

Age in years	20 - 24	25 - 29	30 - 34	35 - 39	40 - 44	45 - 49	50 - 54	55 - 59
No. of staff	0.060	0.104	0.180	0.216	0.192	0.144	0.072	0.032

Table 2

(i)	Estimate each of the following measures about the age of the employees:;

1.	the median; (4 marks)

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II.   the standard deviation.   (4 marks)

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(ii)   The bank is pursuing a programme to restructure its labour force. Employees whose age is below 32 years are to be sponsored for further education awaiting promotion, while those above 52 years of age are to be retired. The rest are to be retained in their current designation. Determine the proportion of employees who will be retained in their current designation.   (4 marks)

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3.   (a)   Define the term *mean* as a statistical measure of central tendency.   (2 marks)

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(b)   Expand the following binomial expression in ascending powers of x.

$(2x + 3y)^6$ (6 marks)

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(c) Convert each of the following number systems to their respective equivalents:

    (i) $8B6E_{16}$ to octal;   (2 marks)

    (ii) 53746_8 to hexadecimal;   (2 marks)

    (iii) 8462_{10} to octal;   (2 marks)

    (iv) 54736_8 to decimal.   (2 marks)

(d) Given the following statistical measures:
- latitude and longitude assigned to a location,
- weights of bags of maize in kilograms,
- positions assigned to students in a class based on academic performance,
- numbers assigned to footballers in a football match,
- temperature in degrees Celsius of patients in a hospital,
- rank numbers assigned to teams in a World Cup tournament,
- marks assigned to students in a class based on academic performance,
- phone numbers assigned to subscribers of a mobile phone network.

Classify these measures into the following measurement scales: nominal, ordinal, interval and ratio. (4 marks)

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4. (a) Differentiate between *absolute value* and *positional value* of a digit as used in number systems. (4 marks)

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(b) A commercial bank uses a ten digit system to assign account numbers to its customers. The first three digits represent the branch number. The account number uses the format "0dd-dddd ddd", where the first character must be the digit zero, the second character must be a non-zero digit and third character must be any numeric digit, the fourth character must be a non-zero digit, the fifth up to the tenth characters must be any numeric digits.

Determine the maximum number of:

(i)   branches which this system can accommodate in general;   (2 marks)

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(ii)   customers which this system can accommodate in general;   (2 marks)

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(iii)   customers, which this system can currently accommodate if the bank has a total of 26 branches.   (3 marks)

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(c)   Explain each of the following logic gates illustrating with logical circuits and truth tables:

(i)   inclusive OR gate;   (3 marks)

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(ii)   AND gate;

(3 marks)

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(iii)   exclusive OR gate.

(3 marks)

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5.   (a)   Explain each of the following terms as used in probability:

(i)   independent events;

(2 marks)

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(ii)   mutually exclusive events.

(2 marks)

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Turn over

(b)   Solve the following simultaneous equations using either elimination or substitution method:

$$5x - 3y = 27$$
$$7y - 2x = 24$$

(4 marks)

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(c)   A room has a rectangular floor with a perimeter measuring 42 feet and a surface area of 108 square feet. Determine the lengths of its two sides.   (4 marks)

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(d)   A soda manufacturing company analysed its past financial records and derived its revenue function given by the equation $R(x) = 12x - x^2 - 15$, and the cost function given by the equation $C(x) = 15 - x$, where x represents the number of crates in hundred thousands with revenue and cost in ten million Kenya shillings. Determine the following about the company:

(i)   The profit function;   (2 marks)

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(ii)   The break-even point(s) for the production;   (2 marks)

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(iii)   The number of crates of soda that maximises profit and the corresponding maximum profit.   (4 marks)

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6.   (a)   (i)   Explain the use of *parity bit* in a computer character coding system.   (2 marks)

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(ii)   Differentiate between odd parity and even parity.   (2 marks)

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(b)   Perform each of the following binary arithmetic operations:

(i) $11010011_2 + 1010101_2$

(2 marks)

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(ii) $11101101_2 - 10110011_2$

(2 marks)

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(c)   A computer security survey was conducted on data backup media by ordinary users in tertiary academic institutions. A random sample of 250 users was taken, and the results were as follows:

- 136   users back up data on flash memory
- 108   users back up data on compact disk
- 90   users back up data on the Internet
- 52   users back up data on flash memory and compact disk
- 46   users back up data on flash memory and the Internet
- 34   users back up data on compact disk and the Internet
- 38   do not back up their data on any of the media
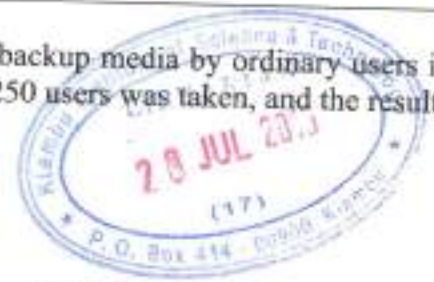
(i)   Represent this information using a Venn diagram.

(6 marks)

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(ii)   Determine the number of users in the study who back up data on:

I.   all the three media;   (2 marks)

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II.   flash memory or compact disk but not the Internet;   (2 marks)

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III.   flash memory and compact disk but not the Internet.   (2 marks)

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7.   (a)   Differentiate between ASCII and EBCDIC as used in character coding systems.
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(b)   Given two matrices $A = \begin{bmatrix} 8 & 4 & 6 \\ 5 & 7 & 2 \\ 3 & 1 & 4 \end{bmatrix}$ and $B = \begin{bmatrix} 2 & 3 \\ 1 & 4 \\ 5 & 2 \end{bmatrix}$

Determine the following:

(i)   the matrix $A \times B$;   (3 marks)

(ii)   the inverse of A using the co-factor method.   (6 marks)

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(c)   A couple comprises a man and a woman both aged 50 years. Research findings show that the probability that a man aged 50 years will survive up to the age of 70 years is $\frac{1}{8}$, while the probability that a woman aged 50 years will survive up to the age of 70 years is $\frac{5}{8}$. Determine each of the following probabilities:

     (i)   that both of them will survive up to the age of 70 years;   (2 marks)

     (ii)   that none of them will survive up to the age of 70 years;   (2 marks)

     (iii)   that only one of them will survive up to the age of 70 years.   (3 marks)

8.   (a)   Outline **four** methods in which an enumerator can administer a questionnaire in the collection of data.   (4 marks)

(b)   Two cars A and B start moving at the same time. Car A starts with fuel of 30 litres and uses one litre of fuel to cover a distance of 6 kilometres while Car B starts with fuel of 40 litres and uses one litre of fuel to cover a distance of 10 kilometres.

    (i)   Formulate a model for the fuel consumption and distance covered by each car.

                                                                       (2 marks)

    (ii)   Determine the distance at which the two cars will have the same amount of fuel.

                                                                         (3 marks)

    (iii)   Which car will cover the longest distance before fuel runs out?   (3 marks)

(c)   Given the equation $f(x) = 2x^3 - 6x^2 + 9x - 2$, use the Newton-Raphson iterative method to find the root of the equation to 6 decimal places. Take the initial root $X_0 = 3.0$.

                                                                         (8 marks)