DICT LEVEL I

COMPUTER MATHEMATICS

MONDAY: 23 November 2020.   **Time Allowed: 3 hours.**

Answer ALL questions. Marks allocated to each question are shown at the end of the question. Show ALL your workings.

QUESTION ONE

(a)   (i)   Explain the term "parity bit" as used in data transmission.   (2 marks)

       (ii)   Outline four disadvantages of BCD code.   (4 marks)

(b)   Convert the following:

       (i)   Binary number 11101110011100111_2 to an octal number.   (2 marks)

       (ii) 268.03125_{10} to hexadecimal.   (2 marks)

       (iii) 2341_5 to base 10.   (2 marks)

(c)   Find the value of X in the following equation:

       $243.62_8 = X_8 - 366.23_8$.   (3 marks)

(d)   Perform the following operations:

       (i)   Convert 4563_{10} into excess $- 3$ (XS $- 3$) code.   (3 marks)

       (ii) $100111_2 \div 11_2$ (2 marks)
                                                                               (Total: 20 marks)

QUESTION TWO

(a)   Define the following terms used in matrices:

       (i)   Diagonal elements.   (1 mark)

       (ii)   Column vector.   (1 mark)

       (iii) Row vector.   (1 mark)

(b)   Find elements x and y satisfying the following matrix equation:

$$\begin{bmatrix} 0 & 2 \\ 4 & 4 \end{bmatrix} = \begin{bmatrix} y + x & z + 1 \\ y - x & x^2 \end{bmatrix}$$

                                                                                        (4 marks)

(c)   Summarise four steps for finding the inverse of a matrix.   (4 marks)

(d)   (i)   Find the inverse of the matrix $\begin{bmatrix} -3 & 2 \\ 5 & -3 \end{bmatrix}$.   (2 marks)

       (ii)   Find the matrix P satisfying the matrix equation below using the inverse of the matrix in (d) (i) above.

$$P \begin{bmatrix} -3 & 2 \\ 5 & -3 \end{bmatrix} = \begin{bmatrix} 1 & 2 \\ 2 & -1 \end{bmatrix}$$

                                                                                        (3 marks)

(e) Show that $AB \neq BA$ in the matrices:

$$A = \begin{pmatrix} 5 & -1 \\ 6 & 7 \end{pmatrix} \quad \text{and} \quad B = \begin{pmatrix} 2 & 1 \\ 3 & 4 \end{pmatrix}$$

(4 marks)
(Total: 20 marks)

QUESTION THREE

(a) (i) In a class, 40% of the students enrolled for Mathematics and 70% enrolled for Economics. 15% of the students enrolled for both Mathematics and Economics.

Required:
The percentage of students who did not enroll for either of the two subjects. (3 marks)

(ii) In a group of 50 people, 35 people ate mangoes and 5 people ate mangoes and bananas.

Required:
The number of people who ate only bananas. (3 marks)

(b) Consider the following sets:

$U = \{1, 2 \ldots . 8, 9\}$

$A = \{1, 2, 3, 4, 5\}$

$B = \{4, 5, 6, 7\}$

$C = \{5, 6, 7, 8, 9\}$

$D = \{1, 3, 5, 7, 9\}$

$E = \{2, 4, 6, 8\}$

$F = \{1, 5, 9\}$

Required:
Show the following sets:

(i) A^c (2 marks)

(ii) B^c (2 marks)

(iii) D^c (2 marks)

(iv) $A - B$ (2 marks)

(v) $B - A$ (2 marks)

(vi) $F - D$ (2 marks)

(c) Prove the identity $(U \cap A) \cup (B \cap A) = A$ (2 marks)
(Total: 20 marks)

QUESTION FOUR

(a) Explain the following terms used in mathematical logic:

(i) Biconditional statement. (2 marks)

(ii) Argument. (2 marks)

(iii) Logical implication. (2 marks)

(b)   Use truth tables to verify that the proposition:

$(p \wedge q) \wedge \sim (p \vee q)$ is a contradiction.   (3 marks)

(c)   Simplify the proposition $\sim (p \vee q) \vee (\sim p \wedge q)$.   (2 marks)

(d)   A computer manufacturer introduced two new brands; Mod1 and Mod2. The cost of manufacturing 15 units of brand Mod1 and 10 units of brand Mod2 was Sh.725,000 while the cost of manufacturing 5 units of brand Mod1 and 8 units of brand Mod2 was Sh.405,000. After selling the brands, the manufacturer made a loss of 10% and 15% on each unit of brand Mod1 and brand Mod2 respectively.

Required:
(i)   Express the cost of making one unit of each brand; Mod1 and Mod2 as simultaneous equations.   (2 marks)

(ii)   The cost of making one unit of each brand.   (5 marks)

(iii) The selling price of one unit of each brand.   (2 marks)
                                                                        (Total: 20 marks)

QUESTION FIVE
(a)   (i)   State the addition law of probability.   (2 marks)

(ii)   Explain the term "independent events" as used in probability theory.   (2 marks)

(b)   Bag A contains 10 apples of which 2 are red and 8 are green. Bag B contains 12 apples of which 4 are red and 8 are green. An apple is drawn at random from each bag.

Required:
(i)   Draw a probability tree diagram to show all the outcomes of the experiment.   (6 marks)

(ii)   The probability that:
       • Both apples are red.   (1 mark)
       • Both apples are green.   (1 mark)
       • One apple is green and the other is red.   (1 mark)
       • At least one apple is red.   (1 mark)

(c)   A supermarket wanted to know the daily demand for pies in its branches in a city. A sample of 20 randomly selected branches from the city produced the following data of pies:

5	1	1	2	0
1	3	3	0	2
1	1	2	1	1
5	1	2	3	4

Required:
Construct a frequency distribution table for this data using single valued classes.   (6 marks)
                                                                        (Total: 20 marks)

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