

UGANDA MARTYRS UNIVERSITY

UNIVERSITY EXAMINATIONS

FACULTY OF SCIENCE

FINAL ASSESSMENT FOR BACHELOR OF SCIENCE IN COMPUTER SCIENCE &
BACHELOR OF SCIENCE EDUCATION

SEMESTER I, 2022/2023

YEAR I/II

MTC 1103: DISCRETE MATHEMATICS

DATE: ???

TIME: 9:30 am – 12:30 pm

DURATION: 3 hours

Instructions

1. Carefully read through ALL the questions before attempting
2. Attempt FOUR questions
3. All questions carry equal marks
4. Ensure that your Registration number is indicated on your booklet and graph paper.

Question 1

- (a) With relevant examples, explain the three methods used to represent a set [3 marks]
- (b) Differentiate between the following terms as used in set theory
- (i) Singleton and binary set [1 mark]
 - (ii) Set difference and set symmetric difference [1 mark]
 - (iii) Sub set and proper sub set [2 marks]
 - (iv) Power set and universal set [2 marks]
- (c) In a survey among 100 people, 50 liked coffee, 30 liked milk, 40 liked tea, 20 liked coffee only, 25 liked tea only, 10 liked tea and coffee and 5 liked all tea, coffee and milk. find the number of people who liked neither of these
- (i) Summarize the above information in set language [4 marks]
 - (ii) Represent the summarized information in a Venn diagram [4 marks]
 - (iii) Find the percentage of people who liked neither drink [2 marks]
 - (iv) Find the percentage of people who liked at least two drinks [2 marks]
- (d) A company that makes a certain brand of chairs has fixed costs of \$5,000 and variable costs of \$30 per chair. The company sells x chairs for \$50 each. Determine the profit function of the company [4 marks]

Question 2

(a) Consider a propositional language where:-

A = "Angelo comes to the party", B = "Bruno comes to the party", C = "Carlo comes to the party", D = "Davide comes to the party".

Formalize the following sentences to Propositional Logic.

(i) "If Davide comes to the party then Bruno and Carlo come too" [2 marks]

(ii) "Davide comes to the party if and only if Carlo comes and Angelo doesn't come" [2 marks]

(iii) "Carlo comes to the party provided that Davide doesn't come, but, if Davide comes, then Bruno doesn't come" [2 marks]

(b) Determine with a reason if each of the following statements below is true or false

(i) $(A \wedge B) \vee (\neg A \wedge \neg B) \equiv A \leftrightarrow B$ [3 marks]

(ii) $(P \rightarrow Q) \wedge (\neg Q \rightarrow \neg P)$ is a tautology.....[3 marks]

(iii) $(\neg P \vee Q) \wedge (Q \rightarrow \neg R \wedge \neg P) \wedge (P \vee R)$ is a contradiction.....[4 marks]

(iv) $(P \rightarrow (Q \rightarrow R)) \rightarrow ((P \rightarrow Q) \rightarrow (P \rightarrow R))$ is a contingency.....[4 marks]

(c) Using De-Morgan's laws to simplify the following expressions

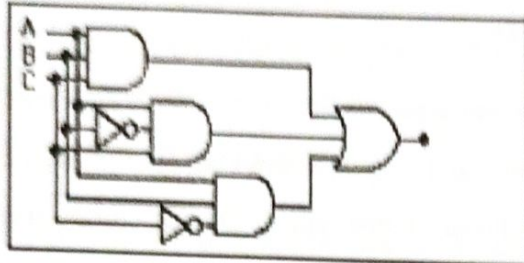
(i) $\overline{(\overline{X + Y + Z})}$[2 marks]

(ii) $\overline{(\overline{W + \overline{X} + Y})} \equiv \overline{Z}$[3 marks]

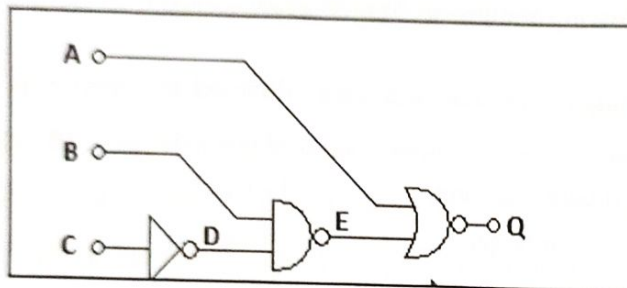
Question 3

(a) Obtain the expression for each of the circuits given below, then simplify and draw equivalent circuit diagram (4 marks)

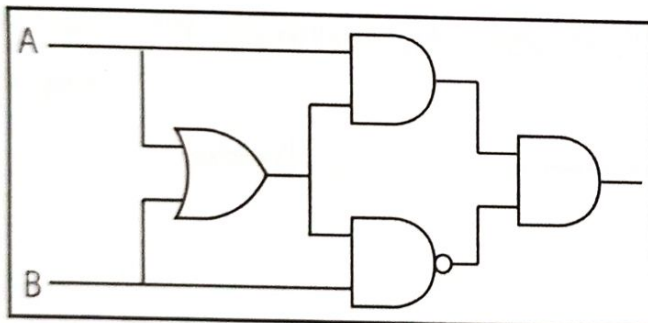
(i) [4 marks]



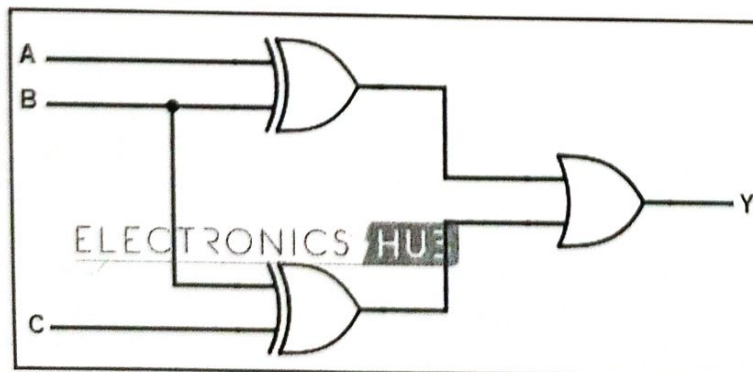
(ii) [4 marks]



(iii) [4 marks]



(iv) [4 marks]



(b) Draw the circuit diagrams for the following Boolean expressions; then simplify and draw simplified circuit diagrams

(i) $\overline{A(\overline{C+D})} + BD$ [3 marks]

(ii) $\overline{AB(C+D)}$ [3 marks]

(iii) $\overline{(X+Y+Z)}$ [3 marks]

Question 4

(a) Find the number of words, with or without meaning that can be formed with the letters of the word 'nakaadongodongot' [2 marks]

(b) Find the number of different words that can be formed with the letters of the word 'BUTTER' so that the vowels are always together [3 marks]

(c) Find the number of permutations of the letters of the word 'REMAINS' such that the vowels always occur in odd places [3 marks]

(d) Simon wants to invest \$15 million in three competing projects. If eight projects for potential investment are shortlisted, determine the number of possible arrangements available for investment decision [3 marks]

(e) Given that $f(x) = \frac{3x-4}{5}$ and $g(x) = 2x^2 - 6x + 10$. Determine

(i) $(f \circ g)(x)$ [3 marks]

(ii) $(g \circ f)(x)$ [3 marks]

(iii) Value of x for which $(f \circ g)(x) = (g \circ f)(x)$ [4 marks]

(iv) $f^{-1}(x)$ [2 marks]

(v) $f \bullet g$ [2 marks]

Question 5

(a) Given that set $Q = \{3, 4, 5, 6\}$ and that set $P = \{1, 2, 3, 4\}$

[3 marks]

(i) Determine a binary relation R from set P to set Q

[2 marks]

(ii) Determine the number of relations in R

(iii) Determine the sub relations form R given by:-

[2 marks]

$$R_1 = \{(a, b) : a < b\}$$

[2 marks]

$$R_2 = \{(a, b) : a + b < 7\}$$

[2 marks]

$$R_3 = \{(a, b) : b - a = 2\}$$

(b) Determine the following combined sub relations:-

[2 marks]

(i) $R_1 \cap R_2$

[2 marks]

(ii) $R_2 \cup R_3$

[2 marks]

(iii) $R_3 - R_2$

[2 marks]

(iv) $R_2 \Delta R_3$

(c) Given a relation defined by $R = \{(1, 2), (2, 3), (2, 4), (2, 2), (3, 2), (4, 1), (1, 1), (3, 3)\}$.

Determine giving a reason whether or not R is:-

[2 marks]

(i) Reflexive

[2 marks]

(ii) Transitive

[2 marks]

(iii) Symmetric

Question 6

(a) Using De-Morgan's laws to simplify the following expressions and draw the equivalent logical diagram for each simplified expression

(i) $\overline{\overline{X + Y + Z}}$ [4 marks]

(ii) $\overline{\overline{W + X + Y}} \cdot \overline{\overline{Z}}$ [5 marks]

(b) Draw logical diagrams for the following Boolean expressions

(i) $((A + B) \cdot C \cdot D \cdot \overline{E})$ [3 marks]

(ii) $\overline{(A + B)} (\overline{C} + (C + D))$ [4marks]

(iii) $\overline{A} \cdot \overline{B} \cdot \overline{B} \cdot \overline{C}$ [3 marks]

Determine the output Q of the expression $\overline{A} + BC + \overline{C} + \overline{D} = Q$ if:-

(i) $A = 1, B = 0, C = 0$ and $D = 0$ [2 marks]

(ii) $A = 1, B = 0, C = 1$ and $D = 0$ [2 marks]

(iii) $A = 0, B = 1, C = 0$ and $D = 1$ [2 marks]

END