UGANDA MARTYRS UNIVERSITY

UNIVERSITY EXAMINATIONS

FACULTY OF EDUCATION

FINAL EXAMINATIONS FOR BACHELOR OF SCIENCE EDUCATION IN EDUCATION

YEAR III

SEMESTER I, 2022/2023

MTC 1103: DISCRETE MATHEMATICS

DATE: ~~22/7/2022~~ 22nd|05|2023

TIME: 9:30 am – 12:30 pm

DURATION: 3 hours

Instructions

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1. Carefully read through ALL the questions before attempting

2. Attempt <u>FOUR</u> questions

3. Indicate the numbers you have done on the front page in their order

4. Ensure that ONLY your Registration number is indicated on the front page

Question 1

a) Using relevant examples, define the following terms as used in set theory

(i) Binary set   **[2 Marks]**

(ii) Proper sub-set   **[2 Marks]**

(iii) Summarize three methods of describing a set   **[3 Marks]**

b) Suppose I discovered that my cat had an appetite for little lizards that live in the bushes of UMU. In one month, suppose he deposited the following in the computer classroom: six gray lizards, twelve lizards that had dropped their tails in an effort to escape capture, and fifteen lizards that he had chewed on a little. Only one of the lizards was gray, chewed on, and tailless; two were gray and tailless but not chewed on; two were gray and chewed on but not tailless. If there were a total of 24 lizards left in the computer classroom that month, and all of the lizards were at least one of "gray", "tailless", and "chewed on". Required:-

(i) Summarize the above information using set language   **[4 Marks]**

(ii) Represent the above information in Venn diagrams   **[5 Marks]**

Determine the number of lizards which were:-

i) Tailless only   **[3 Marks]**

ii) Gray only   **[3 Marks]**

iii) Chewed on only   **[3 Marks]**

Question 2

a) Define the following terms as used in propositional logic

(i) Simple sentence **[2 Marks]**

(ii) Compound sentence **[2 Marks]**

(iii) Logical equivalence **[2 Marks]**

b) Draw truth tables for the following propositional logic functions

(i) PL: $((P \wedge Q) \rightarrow \neg R)$ **[7 marks]**

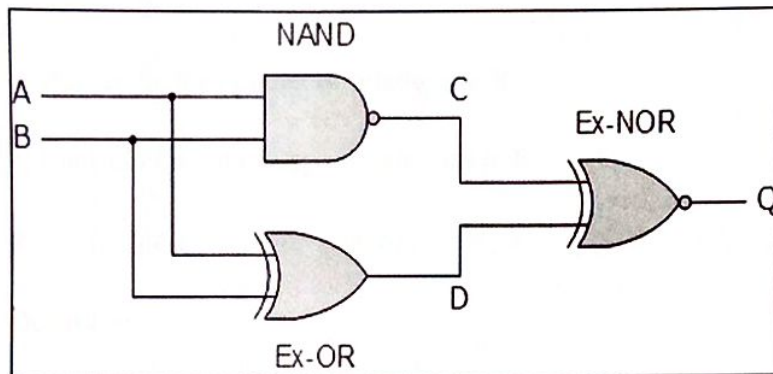(ii) PL: $\neg(P \rightarrow \neg Q)$ V PL: $(P \wedge Q)$ **[7 marks]**

c) Which of the following statements are logically equivalent?

(i) PL: $((P \wedge Q) \rightarrow \neg R)$ and PL: $(P \rightarrow Q) \wedge (Q \rightarrow R)$. **[3 marks]**

(ii) PL: $\neg(P \rightarrow \neg Q)$ and PL: $(P \wedge Q)$ **[2 marks]**

Question 3

a) Given the following circuit below:-

Construct a truth table for the logical functions at point:-

(i) C   [3 marks]

(ii) D   [3 marks]

(iii) Q   [4 marks]

b) Identify a single logic gate that can be used to replace the whole circuit   [5 marks]

c) Use De-Morgan's theorem to simplify the following Boolean expressions

(i) $\overline{A.B}$ [2 marks]

(ii) $\overline{A+B}$ [2 marks]

(iii) $\overline{A+\overline{BC}}$ [3 marks]

(iv) $\overline{AB+CD}$ [3 marks]

Question 4

a) Define a binary relation R from set Q = {6, 7, 8} to set P = {1, 2, 3, 4} **[6 marks]**

b) Determine the number of relations in R **[3 marks]**

c) Consider the following sub relations in R:-

$R_1 = \{ (a, b) \mid a \leq b \}$; $R_2 = \{ (a, b) \mid a > b \}$; $R_3 = \{ (a, b) \mid a = b - 2 \}$ and $R_4 = \{ (a, b) \mid a = b + 1 \}$

Determine:-

(i) $R_1 \cap R_2$ **[4 marks]**

(ii) $R_2 \cup R_4$ **[4 marks]**

(iii) $R_3 - R_2$ **[4 marks]**

(iv) $R_2 \; \Delta \; R_4$ **[4 marks]**

Question 5

a) Define the following terms

(i) A Boolean algebra **[3 Marks]**

(ii) n - bit sequence **[3 Marks]**

(iii) A logic gate **[3 Marks]**

b) Suppose the input data consists of a 4 – bit sequence given by the following:

A = 1101 and B = 0101. Determine the following outputs:

(i) NOT gate **[2 Marks]**

(ii) OR gate **[2 Marks]**

(iii) AND gate **[2 Marks]**

c) Construct circuits that produce the following out puts

(i) $(X + Y)X'$ [5 Marks]

(ii) $X'.(Y + Z)'$ [5 Marks]

Question 6

a) Given the following sets:-

$A = \{ x : x \in N \le 15 \}$, $P = \{2, 3, 4, 5, 6, 7\}$, $Q = \{0, 3, 6, 9, 12\}$ and $R = \{2, 4, 6, 8\}$.

Determine:-

(i) ε [3 marks]

(ii) $P \cup Q$ [2 marks]

(ii) $P \cap R$ [2 marks]

(ii) A^C [2 marks]

(iv) $A - P$ [3 marks]

(v) $P \Delta Q$ [3 marks]

(vi) $P \times R$ [5 marks]

b) Explain any one application of sets in a real life situation [5 marks]

END