UGANDA MARTYRS UNIVERSITY

UNIVERSITY EXAMINATIONS

FACULTY OF SCIENCE

FINAL EXAMINATIONS FOR BACHELOR OF SCIENCE IT, BACHELOR OF SCIENCE GENERAL & BACHELOR OF NATURAL RESOURCE MANAGEMNET

YEARS I & III

SEMESTER I, 2023/2024

MTC 1102: ELEMENTS OF MATHEMATICS

DATE: THURSDAY; 14/12/2023

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, state two basic properties used to represent a set   [3 marks]

In a class of Mathematics students, 15 take Agriculture and German, 17 take German and French, 13 take French and Agriculture, 6 take French only, 6 take Agriculture only and 3 German only. 3 take all the three subjects.

Determine: -

(i) Summarize the above information using set language   [6 marks]

(ii) Represent the above information in Venn diagrams   [6 marks]

(iii) The total number of students in the mathematics class   [2 marks]

(iv) The percentage of students who take two subjects only   [2 marks]

(v) The number of students who take at most two subjects   [3 marks]

(vi) The number of students who take at least two subjects   [3 marks]

Question 2

(a) Given a set $A = \{1, 2, 3, 4\}$. Determine a binary relation R on A   [7 marks]

(b) Determine the following sub relations from R

(i) $R_1 = \{(x, y): x \leq y\}$ [3 marks]

(ii) $R_2 = \{(x, y): x > y\}$ [3 marks]

(iii) $R_3 = \{(x, y): x = y - 1\}$ [3 marks]

(iv) $R_4 = \{(x, y): xy > 16\}$ [3 marks]

(c) Determine $R_1 \triangle R_3$ [3 marks]

(d) Determine $R_1 - R_3$ [3 marks]

Question 3

Given the following complex numbers $z_1 = 3 - 2i$ and $z_2 = -5 + 7i$. Determine: -

(i) $z_1 + z_2$ **[4 marks]**

(ii) $z_1 - z_2$ **[4 marks]**

(iii) $z_1.z_2$ **[4 marks]**

(iv) arg z_1 **[4 marks]**

(v) $\left(z_1\right)^{20}$ **[5 marks]**

(vi) Represent z_1 and z_2 on Argand diagram   **[4 marks]**

Question 4

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) Determine whether or not each of the following propositional logic functions is a tautology, contradiction or a contingency

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

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

c) Determine if $((P \wedge Q) \rightarrow \neg R) \equiv (P \rightarrow Q) \wedge (Q \rightarrow R)$ **[5 marks]**

Question 5

(a) Given the following circuit diagram. Determine: -

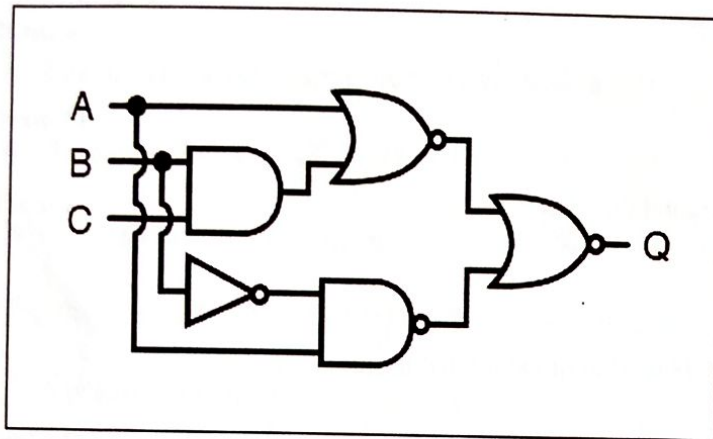(i) The output Q   **[3 marks]**

(ii) Simplified version of Q   **[3 marks]**

(iii) Equivalent circuit diagram of Q   **[3 marks]**

(b) Given the following Boolean outputs R = XY(Y'Z + XZ) and P = $\overline{\overline{A + BC} + \overline{\overline{AB}}}$. Draw a circuit diagram for the following outputs: -

(i) R   **[4 marks]**

(ii) P   **[4 marks]**

(iii) Simplify outputs R and P and draw equivalent circuit diagrams   **[4 marks]**

(iv) Describe the applications of logic gates in real life   **[4 marks]**

END