

UGANDA MARTYRS UNIVERSITY

UNIVERSITY EXAMINATIONS

FACULTY OF SCIENCE

FINAL EXAMINATIONS FOR BACHELOR OF SCIENCE IN COMPUTER  
SCIENCE

YEARS I & III

SEMESTER I, 2023/2024

MTC 1103: DISCRETE MATHEMATICS

DATE: THURSDAY; 14/12/2023

TIME: 9:30 am – 12:30 pm

DURATION: 3 hours

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**Instructions**

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1. Carefully read through ALL the questions before attempting
2. Attempt FOUR 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) Given set  $P = \{1, 2, 3, 4\}$ . Determine the binary relation  $R$  on set  $P$  [3 marks]

(b) Determine the following sub relation from  $R$ :-

i.  $R_1 = \{(x, y): x = y\}$  [2 marks]

ii.  $R_2 = \{(x, y): x \leq y\}$  [2 marks]

iii.  $R_3 = \{(x, y): 2x + y \leq 7\}$  [2 marks]

iv.  $R_4 = \{(x, y): y \leq x\}$  [2 marks]

(c) Investigate giving a reason whether the sub relation  $R_2$  possesses the following properties: -

i. Identity relation [2 marks]

ii. Reflexive relation [2 marks]

iii. Symmetric [2 marks]

(d) Combine the following relations

i.  $R_1 \Delta R_2$  [3 marks]

ii.  $R_4 - R_3$  [3 marks]

(e) Explain the usefulness of relations in computer science [5 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)  $((P \wedge Q) \rightarrow \neg R)$  [7 marks]

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

c) Determine whether the following statement is logically equivalent or not

(i) PL:  $((P \wedge Q) \rightarrow \neg R)$  and PL:  $(P \rightarrow Q) \wedge (Q \rightarrow R)$ .

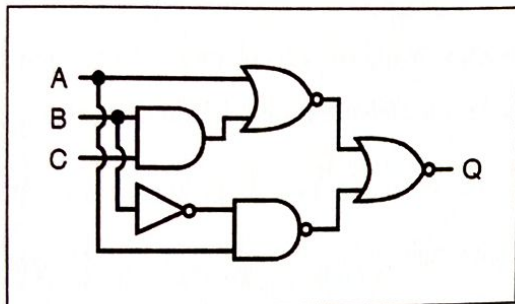
[3 marks]

(ii) PL:  $\neg(P \rightarrow \neg Q)$  and PL:  $(P \wedge Q)$

[2 marks]

### Question 3

a) Given the following circuit below: -



i. Write the Boolean function for output Q

[3 marks]

ii. Simplify the output Q and draw its simplified circuit diagram

[3 marks]

b) Use Boolean algebra laws and De-Morgan's theorem to simplify the following Boolean expressions

i.  $P = A'BC' + A'BC + ABC' + ABC$

[3 marks]

ii.  $F = ABC + \bar{A} + \bar{A}BC$

[3 marks]

iii.  $Q = (A + AB)(B + BC)(C + AB)$

[4 marks]

iv.  $R = \overline{(A + B)(AB)} + \overline{(A + B)(\bar{A}B)}$

[4 marks]

c) Explain one practical application of logic gates in real life

[5 marks]

#### Question 4

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) In a survey of 44 holiday makers, 22 have been to Gulu, 21 have been to Mbale, 9 have been to Kabale only and six have been to all the three cities. 10 have been to Gulu and Mbale, 11 to Gulu and Kabale and three have been to Kabale and Mbale only.

(i) Summarize the above information using set language

[4 Marks]

(ii) Represent the above information in Venn diagrams

[5 Marks]

(iii) Determine the number of holiday makers who did not visit either city

[3 marks]

(iv) Determine the percentage of holiday makers who visited at least 2 cities

[3 marks]

(iv) Determine the percentage of holiday makers who visited at most 1 city

[3 marks]



### Question 5

- a) With an example in each case, differentiate between a permutation and a combination [2 marks]
- b) A password consists of 10 digits. If the first four digits are numbers and the remaining digits are letters; how many passwords can be formed [2 marks]
- c) Determine the number of ways of choosing 8 objects from a set of 25 objects if: -
- i. Order matters and repetition is not allowed [2 marks]
  - ii. Order does not matter and repetition is allowed [2 marks]
- d) Describe the applications of permutations and combinations in computer science [4 marks]
- e) Given the following functions
- $$f(x) = 2x + 4, \quad g(x) = 3x^2 - 4x \text{ and } h(x) = 6x^3 + 5x$$
- f) Determine the following
- i.  $(g + f - h.f)(x)$  [3 marks]
  - ii.  $(goh)(x)$  [3 marks]
  - iii.  $(hog)(x)$  [3 marks]
  - iv. The value of  $x$  for which  $(goh)(x) = (hog)(x)$  [3 marks]
- g) Explain the applications of functions in computer programming [4 marks]

END