



(The University of Choice)

**MASINDE MULIRO UNIVERSITY OF
SCIENCE AND TECHNOLOGY
(MMUST) MAIN
CAMPUS**

UNIVERSITY EXAMINATIONS

2022/2023 ACADEMIC YEAR

FIRST YEAR FIRST SEMESTER EXAMINATIONS

FOR THE DEGREE

OF

BACHELOR OF SCIENCE (COM, SIT, SPA, SME, SMT, SST, EDS, SIK)

COURSE CODE: BIT 111 /BCS 112

COURSE TITLE: DISCRETE STRUCTURES

DATE: 14/12/2022

TIME: 3.00 – 5.00PM

INSTRUCTIONS TO CANDIDATES

Answer question ONE (compulsory) and any **TWO** questions

This Paper Consists of 4 Printed Pages. Please Turn Over ►

QUESTION ONE (30MKS)

- a) Given that set $A = \{a, b, c, d\}$ (3mark)
- i) Find all the total number of subsets of A (1mark)
 - ii) Determine the power of set A (1mark)
 - iii) State the cardinality of set A
- b) Define the following (2mark)
- i) Reflexive relation (2mark)
 - ii) A binary tree (1mark)
- c) Construct circuit that produces the out put $XY + \bar{X}Y$ (5mark)
- d) Prove that for every integer x , $x(x+1)$ is even.
- e) Verify that $\overline{A+B} = \bar{A} \cdot \bar{B}$ using de-morgans laws and the rules of Boolean algebra (5 marks)
- f) Given that $f(x) = 7x - 4$.
- i) Find the inverse of $f(x)$, (3marks)
 - ii) Verify that $f \cdot f^{-1}(x) = x$ (3 marks)
- g) Convert 11011_2 to decimal number system (4 marks)

QUESTION TWO (20MKS)

- a) Given that set $A = \{1, 2, 3, 6\}$ is related to set B , $B = \{3, 4, 5, 7\}$ by relation $T = \{(1, 3), (1, 4), (1, 5), (2, 3), (3, 3)\}$ and set B is related to set C , $C = \{1, 2, 3, 4\}$ by relation $Q = \{(3, 1), (3, 2), (3, 3), (4, 3), (4, 4)\}$. Find (9 marks)
- i) T^{-1}
 - ii) $(Q^{-1})^{-1}$
 - iii) $Q \circ T$
 - iv) $T \circ Q$
- b) Prove that $5 + 10 + 15 + \dots + 5n = \frac{5n(n+1)}{2}$ is true for every positive integers (5 marks)
- c) Convert 47_{10} to a binary number system (3 marks)
- d) Divide using synthetic division $(4x^3 - 2x + 3) \div (x + 1)$ (3 marks)

QUESTION THREE (20MKS)

- a) Show that $A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$ (5 marks)
- b) Consider three sets A, B and C. Set A contains a elements, B contains b elements, C contains c elements. Both A and B contains w elements, B and C contains x elements, A and C contains y elements. All the three sets A, B and C contains z elements.
- Draw the venn diagrams to show the above information
 - Determine
 - Number of elements related only to A
 - Number of elements related only to B
 - Number of elements related only to C
 - Number of elements related only to A and B
 - Number of elements related only to A and C
 - Total number of elements related to all the three sets
- (10 marks)
- c) Find the GCD of 999 and 123 using Euclidean algorithm. (5 marks)

QUESTION FOUR (20MKS)

- a) Draw the correct logical gates symbol for the following names (5 marks)
- AND
 - NOT
 - NOR
 - XOR
 - NAND
- b) Devise a logical circuit to meet the requirement of the output given in the table below (8mks)

INPUT			OUTPUT
A	B	C	Z
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

- c) Show that $f : R \rightarrow R$ defined as $f(a) = 3a^2 - 4$ is one to one function (3 marks)
- d) Given three functions; $f(x) = x$, $g(x) = 2x - 7$, $h(x) = x - 1$. Find $f \circ (g \circ h)(-2)$ (4 marks)

QUESTION FIVE (20MKS)

- a) Express $\gcd(500, 222) = 2$ as a linear combination of 500×222 using Bezouts theorem. (6 marks)
- b) A village Baraza consists of 9 men and 12 women, how many ways can a committee consisting of 5 men and 3 women be chosen. (5 marks)
- c) By giving an illustration , differentiate between n-cube graphs and complete graphs as used in special graphs (4 marks)
- d) Find the optimal Huffman code for the following table of symbols. (5 marks)

Character	Frequency
A	2
B	3
C	7
D	8
E	12