



MACHAKOS UNIVERSITY

University Examinations for 2022/2023 Academic Year

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF MATHEMATICS AND STATISTICS

FIRST YEAR FIRST SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (COMPUTER SCIENCE & CLOUD COMPUTING)

SCO 108: DISCRETE MATHEMATICS

DATE:

TIME:

INSTRUCTIONS TO CANDIDATES

(a) Answer ALL the questions in ONE and ANY TWO

QUESTION ONE (COMPULSORY) (30 MARKS)

- a) Define the following terms.
- i) A power set
 - ii) A symmetric difference
 - iii) Integer
 - iv) Natural number
 - v) A subset (5 marks)
- b) Determine the power set of the set $A = \{a, b, c, d\}$. (3 marks)
- c) Construct the logic circuit for $Y = (A + C)' + (A'B + BC)$ (5 marks)
- d) Construct the truth table for the conjunction of two proposition (4 marks)
- e) In how many distinguishable ways can the product $A^7 B^8 C^7 D^6$ be arranged without using exponents. (3 marks)
- f) Given $A = ((abc)'c)'(a' + c)(b' + ac)'$ express it as a sum of product expression. (5 marks)
- g) State and prove the hand shake Lemma. (5 marks)

QUESTION TWO 20 MARKS

- a) Construct the logic circuit for the following output $Y = (AC + BC) + (A' + BC)'$ (5 marks)
- b) Show that D_{70} (where D_{70} are divisors of 70) is a Boolean algebra
- i) Determine the atoms (3 marks)
 - ii) Determine the subalgebra (3 marks)
 - iii) Construct the lattice diagram (4 marks)
- c) Given that $A = 01101010$ $B = 01010110$ $C = 00110010$ $D = 01000111$. Determine $Y = A.B.C.D + A$ (5 marks)

QUESTION THREE 20 MARKS

- a) A market researcher investigating consumer preference for three brands of soda namely, coke, fanta and sprite in a certain town gathered the following information; from a sample of 800 consumers 230 took coke 245 took fanta and 325 took sprite. 30 took all the three brands of soda, 70 took coke and sprite, 110 took coke only, 185 took sprite only. Required
- i) Present the above information in a venn diagram (4 marks)
 - ii) Determine the number of customers who took fanta only (4 marks)
 - iii) Determine the number of customers who took coke and fanta only (4 marks)
 - iv) Determine the number of customers who took fanta and sprite only (4 marks)
 - v) Determine the number of customers who took none of the brands of soda. (4 marks)

QUESTION FOUR 20 MARKS

- a) Prove that the square of an even integer is even and the square of an odd integer is odd. (6 marks)
- b) Show that $\sqrt{2}$ is irrational (5 marks)
- c) Proof that set of all even natural numbers is countable. (5 marks)
- d) Prove the proposition $p(n)$ that the sum of the first n positive integers is $\frac{1}{2}n(n + 1)$ that is $p(n) = 1 + 2 + 3 + \dots + n = \frac{1}{2}n(n + 1)$ (4 marks)

QUESTION FIVE 20 MARKS

- a) Let $U = \{1,2,3,4,5,6,7,8,9,10,11,12\}$, $A = \{1,3,5,7,9,11\}$ $B = \{2,3,5,7,11\}$
 $C = \{2,3,6,12\}$ and $D = \{2,4,8\}$.

Determine the set

- i) $A \cup B$
- ii) $A \cap C$
- iii) $(A \cup B) \cap C^c$
- iv) $(C \cap A) \cup D$ (8 marks)
- b) Let $A = \{z, a\}$ and $B = \{0,5,4\}$ determine the set
 $(A \times B)$ (2 marks)
- c) A committee of 8 people is to be selected from 8 women and 6 men. In how many ways:
- i) Can the committee be selected if at least seven women must be in the committee? (3 marks)
- ii) Can the committee be selected if three men must be in the committee? (3 marks)
- d) Show that $(p \vee q)$ and $(p \wedge q)$ are logically equivalent (4 marks)