namibia university
OF SCIENCE AND TECHNOLOGY

FACULTY OF HEALTH, APPLIED SCIENCES AND NATURAL RESOURCES

DEPARTMENT OF MATHEMATICS AND STATISTICS

QUALIFICATION: Bachelor of science ; Bachelor of science in Applied Mathematics and Statistics	
QUALIFICATION CODE: 07BSAM; 07BOSC	**LEVEL:** 5
COURSE CODE: MAS501S	**COURSE NAME:** MATHEMATICAL STRUCTURES
SESSION: JUNE 2022	**PAPER:** THEORY
DURATION: 3 HOURS	**MARKS:** 100

FIRST OPPORTUNITY EXAMINATION QUESTION PAPER	
EXAMINER	Mr B.E OBABUEKI
MODERATOR:	Prof S.A REJU

INSTRUCTIONS
1. Answer ALL the questions in the booklet provided.
2. Show clearly all the steps used in the calculations where necessary.
3. All written work must be done in blue or black ink and sketches must be done in pencil.

PERMISSIBLE MATERIALS

1. Non-programmable calculator without a cover.

THIS QUESTION PAPER CONSISTS OF 3 PAGES (excluding this front page)

Question 1 (15 marks)

1.1   Subtract the number $7F.ABCDEF_{16}$ from the number $FD.3256_{16}$.   (4)

1.2   Convert the number 245.3_6 to base 7 correct to 2 places after the point.   (7)

1.3   Use the grouping of digits to convert $30F.4E2_{16}$ to octal.   (4)

Question 2 (28 marks)

2.1   Let $\Omega = \{1,2,3,4,5,6,7,8,9,a,b,c,d,e\}$ be a universal set and let $A = \{1,3,5,7,9,b,d\}$, $B = \{2,4,6,7,9,a,b,c\}$ and $C = \{2,5,7,9,a,b\}$ be subsets of Ω.

2.1.1   Draw a Venn diagram to represent this information.   (7)

2.1.2   Write down the power set $P(A \cap B \cap C)$.   (4)

2.2   Among the 133 students at school, 44 take Geography, 48 take Biology, 32 take Mathematics, 8 take both Geography and Biology, 9 take Geography and Mathematics, 7 take Biology and Mathematics. 30 students take none of the three subjects.

2.2.1   Draw a Venn diagram to represent this information.   (5)

2.2.2   Use the formula
$$n(G \cup B \cup M) = n(G) + n(B) + n(M) - n(G \cap B) - n(G \cap M) - n(B \cap M) + n(G \cap B \cap M)$$
to determine $n(G \cap B \cap M)$.   (3)

2.2.3   How many students take Geography or Biology?   (2)

2.2.4   How many students take Biology and Mathematics but not Geography?   (1)

2.3   Given that A and B are subsets of the same universal set, prove that $(A' \cup B)' \subseteq A \cap B'$.   (6)

Question 3 (10 marks)

3.1   Consider the following statements

p: Peter went to school

q: Queen ate an apple

r: Russel missed his soccer practice

a: Agnes cried.

Write the statement *If Peter did not go to school and Queen ate an apple, then either Russel missed his soccer practice or Agnes did not cry* in symbolic logic. (5)

3.2   Use a truth table to determine whether the two statements $(A' \vee B)'$ and $A \wedge B'$ are contradictions, a tautology, equivalent or none of these. (5)

Question 4 (17 marks)

4.1   Write a pseudocode that reads the names, gender and ages of 1000 persons and outputs the average age of the males. (10)

4.2   Draw a flow chart that solves the linear equation $ax + b = c$ and outputs the result. Your program must test whether $a = 0$. (7)

Question 5 (15 marks)

5.1   Draw the logic circuit for the Boolean expression $E(X,Y,Z) = \overline{\overline{XY}\,Z} + \overline{X}\,YZ + \overline{\overline{\overline{X}\,Y}}$. (6)

5.2   Express $\overline{A + B} + \overline{AB}\,C + \overline{A + BC} + \overline{B}$ in a sum of products form. (5)

5.3   Copy the table below and use the following logic circuit to complete it: (4)
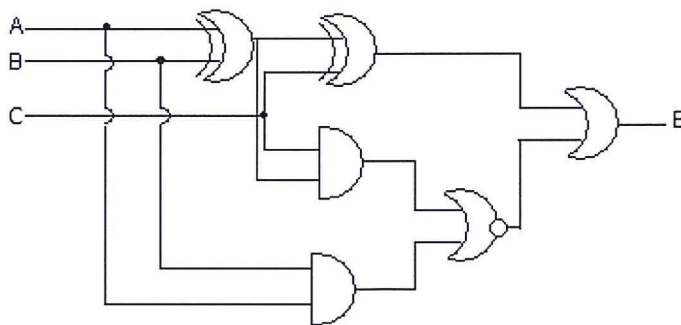
A	B	C	E
0	1	0	
1	0	1	
1	1	0	
0	0	1	

Question 6 (15 marks)

6.1   Use mathematical induction to prove that the sum of the first n odd natural numbers is n^2. (7)

6.2   Prove that the product of two odd numbers is odd. (8)

END OF PAPER.   **Total Marks 100**