NAMIBIA UNIVERSITY
OF SCIENCE AND TECHNOLOGY

FACULTY OF HEALTH, NATURAL RESOURCES AND APPLIED SCIENCES

SCHOOL OF NATURAL AND APPLIED SCIENCES

DEPARTMENT OF MATHEMATICS, STATISTICS AND ACTUARIAL SCIENCE

QUALIFICATION: Bachelor of science in Applied Mathematics and Statistics	
QUALIFICATION CODE: 07BSAM	**LEVEL**: 5
COURSE CODE: MAS501S	**COURSE NAME**: MATHEMATICAL STRUCTURES
SESSION: JULY 2023	**PAPER:** THEORY
DURATION: 180 MINUTES	**MARKS**: 100

SUPPLEMENTARY/SECOND OPPORTUNITY QUESTION PAPER	
EXAMINER	MR. B.E OBABUEKI
MODERATOR:	PROFESSOR SUNDAY REJU

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

PERMISSIBLE MATERIALS

Non-programmable calculator without a cover.

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

Question 1 (26 marks)

1.1 Do the following sums in the indicated number systems:

1.1.1 $2122.022_3 + 2212.21_3 + 21212.0212_3 + 222.2222_3$ (5)

1.1.2 $6623.365_7 - 4644.3662_7$ (4)

1.2 Do the following conversions:

1.2.1 3465.32_8 to base 10 correct to 2 decimal places. (4)

1.2.2 523.67_{10} to base 8 correct to 4 octal places. (6)

1.3 Perform the following conversions directly.

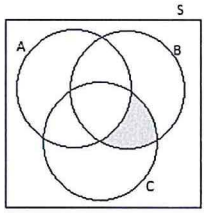
1.3.1 $A2D0.2AF_{16}$ to binary (4)

1.3.2 100111000.0111_2 to octal (3)

Question 2 (20 marks)

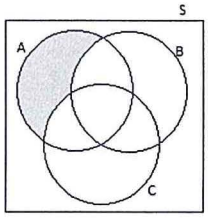
2.1 Write down what subset is represented by each of the following Venn diagrams:

2.1.1



(2)

2.1.2



(2)

2.2 Define each of the following terminologies as used in set theory:

Subset, **Power set**, and **Direct sum** of two sets. (6)

2.3 State the two D'Morgan's Laws for sets. No proof required. (4)

2.4 Given that A and B are subsets of S, prove that $A' \cup B'$ is a subset of $(A \cap B)'$. (6)

Question 3 (14 marks)

3.1 Write the following compound statement in logic symbolic form: *"If the rain falls and the sun shines, then John will bring Mary along if she gets her new shoes".* (Remember to state your four variables in this case.) (5)

r: rain falls; s: sun shines;

j: John brings Mary; m: Mary gets new shoes

3.2 Copy and complete the following truth table: (Note that $\neg$ means negation) (5)

A	B	C	$\neg A \Rightarrow B$	$C \wedge \neg B$	$A \Rightarrow (B \vee C)$	$\neg(A \vee B)$	$\neg(A \wedge B \wedge C)$
T	F	T					
T	T	F					
F	T	T					
F	F	F					
T	F	F					

3.3 Use a truth table to investigate whether the following statements are logically equivalent or not:

Statement 1: *"All the intelligent students passed"*

Statement 2: *"A student that did not pass is not intelligent"*

(Hint: Let "*student passed* be ***p*** and let *student is intelligent* be ***q***") (4)

Question 4 (12 marks)

There are 100 positive whole numbers. Some of the numbers are even and the others odd.

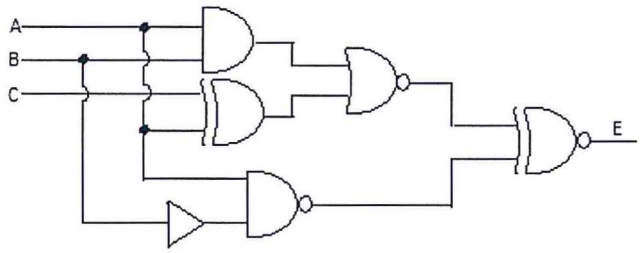
Write a pseudocode that finds and prints the average of only the **odd** numbers. (12)

Question 5 (17 marks)

5.1 Draw the logic circuit of the Boolean expression $E(A,B,C) = A\overline{B} + \overline{A + \overline{BC}} + \overline{AB}C$. (7)

5.2 Simplify the Boolean expression $B(x,y,z) = \overline{\overline{x+y}} + \overline{x}\,\overline{yz} + x\overline{(y+z)}$. (5)

5.3 Study the following logic circuit:



Draw the following table in your answer script and use the logic circuit to complete it. (5)

A	1	0	1	1	0
B	1	1	0	0	0
C	1	1	1	0	0
E					

Question 6 (11 marks)

6.1 Prove that the sum of two even natural numbers is even. (5)

6.2 Use mathematical induction to prove that the sum of the first n odd natural numbers is n^2. (6)

End of paper **Total marks: 100**