



higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

LOGIC SYSTEMS N4

(8080284)

29 November 2019 (X-paper)
09:00–12:00

This question paper consists of 5 pages.

DEPARTMENT OF HIGHER EDUCATION AND TRAINING
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LOGIC SYSTEMS N4
TIME: 3 HOURS
MARKS: 100

INSTRUCTIONS AND INFORMATION

1. Answer ALL the questions.
 2. Read ALL the questions carefully.
 3. Number the answers according to the numbering system used in this question paper.
 4. Start each question on a NEW page.
 5. Keep questions and subsections of questions together.
 6. Answer the questions with a blue or black pen and use a pencil for the drawings.
 7. ALL the sketches and diagrams must be large, clear and neat.
 8. ALL calculations must be shown.
 9. Calculations and calculated answers must be given to THREE fractional radix spaces, for example $10,101_2$
 10. Write neatly and legibly.
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QUESTION 1

1.1 Give the symbols of the binary number system. (1)

1.2 What is the decimal value of a binary 1 which is in the third position to the left of the radix comma?  (1)

1.3 Give the biggest symbol in the decimal number system. (1)

1.4 Determine the one's complement of 11000101_2 (2)

1.5 What do the following abbreviations stand for?

1.5.1 RAM

1.5.2 CD-RW



(2 × 1) (2)

1.6 Give the symbol, the truth table and the Boolean expression for an exclusive OR gate. (3)

1.7 Simplify the Boolean expressions below:

1.7.1 $A\bar{A} + B\bar{B}$

1.7.2 $AB\bar{C} + AB + 1$



1.7.3 $BCD + B + B\bar{C}\bar{D}$

1.7.4 $AB\bar{B} + A\bar{B}\bar{A}$

(4 × 1) (4)

1.8 Determine the simplest Boolean expression for the Karnaugh maps given below. Redraw each Karnaugh map and show the groupings.

1.8.1

		AB			
		00	01	11	10
CD	00			1	1
	01			1	1
	11	1	1		1
	10	1	1	1	1

1.8.2

		AB			
		00	01	11	10
CD	00		1	1	
	01	1			1
	11	1		1	1
	10	1			1



1.8.3



AB \ CD	00	01	11	10
00	1			Ø
01	1	Ø	Ø	1
11	Ø			
10	1	1	1	1

(3 × 2) (6)
[20]**QUESTION 2**

2.1 Convert each of the following numbers to their binary equivalents and then complete the calculations in the binary number system: Show all conversions.

2.1.1 $16,25_{10} - 17,6_8$. Use two's complement subtraction.
Convert the final answer to the octal system.

2.1.2 $148,35_{10} \times 16,8_8$ 
Convert the final answer to the hexadecimal system.

2.1.3 $647,3_8 \div 16,25_{10}$
Convert the final answer to the decimal system

(3 × 6) (18)

2.2 What does ASCII stand for? 

(2)

2.3 Encode the following into the ASCII code:

@ C a T !

(5)
[25]**QUESTION 3**

3.1 Draw the circuit diagram of the following Boolean expression below. DO NOT change or simplify the expression:

3.1.1 $F = \overline{(\overline{A} + \overline{B} + C)}(\overline{AB}) + (A + B)$

3.1.2  $F = \overline{(\overline{AB} \oplus C) + \overline{AB} + \overline{BC}}$

3.1.3 $F = \overline{ABC} + \overline{ABC} + (A + BC)$

(3 × 5) (15)

3.2 Simplify the Boolean expressions below by using Boolean laws. Draw the simplified circuit diagrams by using NAND gates only.

3.2.1  $F = A(A + B + C) (\bar{B} + \bar{C}) (\bar{A} + B + C)$

3.2.2 $F = AB + \overline{ABC + AB + AC}$

(2 × 5)

(10)
[25]

QUESTION 4

With the aid of Karnaugh maps, design a circuit that will convert the 8421 BCD code with four variables (A, B, C, D) to the excess-3 code. Simplify the circuit with the aid of Boolean algebra so that it consists of the minimum number of gates. 

[20]

QUESTION 5

Make a neat, labelled sketch of a Schmitt trigger which makes use of NPN transistors. Also give the input waveform in relation to the output waveform to indicate how a sine wave will be converted to a square wave. Label the sketches in full.



[10]

TOTAL:**100**