higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

LOGIC SYSTEMS N4

(8080284)

29 November 2022 (X-paper)
09:00–12:00

Drawing instruments may be used, but calculators may NOT be used.

This question paper consists of 5 pages.

286Q1E2229

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DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
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 correctly according to the numbering system used in this question paper.
4. Calculations and calculated answers must be given in THREE fractional radix spaces, for example $10{,}101_2$ unless a hexadecimal conversion is required or if stated otherwise.
5. All the sketches and diagrams must be large, clear and neat.
6. All calculations must be shown.
7. Start each question on a new page.
8. Questions must be answered with a blue or black pen and all drawings must be done in pencil.
9. Write neatly and legibly.

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QUESTION 1

1.1 What is the radix of the octal number system? (1)

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

1.3 Determine the two's complement of 10111101_2. (2)

1.4 Give the symbol, truth table and Boolean expression of the NOR gate. (3)

1.5 What are the voltage values of logic 1 and logic 0 in the TTL system? (2)

1.6 State the main difference between a *full adder* and a *half adder*. (1)

1.7 Simplify the Boolean expressions below:

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

1.7.2 $1 + A\bar{B}C(\bar{A}B\bar{C})$

1.7.3 $\bar{A}\bar{B} + AB$

1.7.4 $\overline{C + \bar{C}}$

(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

CD \ AB	00	01	11	10
00	1	1	1	1
01	0	1	1	0
11	1	1	1	1
10	1	0	0	1

1.8.2

CD \ AB	00	01	11	10
00	0	0	0	0
01	1	1	1	0
11	0	0	0	0
10	1	0	0	1

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1.8.3

CD \ AB	00	01	11	10
00	1	Ø	Ø	Ø
01	1	0	0	0
11	0	1	Ø	Ø
10	1	1	0	0

(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 $12{,}75_{10} - F{,}D_{16}$. Use one's complement subtraction.

Convert the final answer to the decimal system.

2.1.2 $4C{,}A_{16} \times 2{,}4_{8}$

Convert the final answer to the octal system.

2.1.3 $731{,}2_{8} \div 16{,}25_{10}$

Convert the final answer to the hexadecimal system.

(3 × 6) (18)

2.2 Encode or decode the following to the code/number system indicated:

2.2.1 123_{10} to the GRAY code (3)

2.2.2 The 2421 BCD code 01110101 to its decimal equivalent (2)

2.2.3 1000 0011 XS3 (Excess 3) code to decimal (2)
[25]

QUESTION 3

3.1 Draw the circuit diagram of the following Boolean expressions below. Do NOT change or simplify the expressions:

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

3.1.2 $F = \overline{\overline{AB\bar{C}D + A\bar{B}C\bar{D} + A\bar{B}C}}$

3.1.3 $F=\overline{(\overline{A}+\overline{B})(A+\overline{B})}\ \overline{(A\oplus B)}$

(3 × 5) (15)

3.2 Use Boolean algebra to simplify the following Boolean equations:

3.2.1 $F=\overline{(A\overline{B}C+AB\overline{C})}\ .\ \overline{(A\overline{B}\,\overline{C}+ABC)}$ (4)

3.2.2 $F=\overline{(A+\overline{B}+\overline{C})(\overline{A}+C)}\ .\ \overline{(A+B)}$ (6)

[25]

QUESTION 4

With the aid of Karnaugh maps and the table below, design a circuit that will convert the 8421 BCD code with FOUR variables (A, B, C, D) to the GRAY code. Simplify with the aid of Boolean algebra so that the circuit consists of THREE exclusive NOR (XNOR) gates only.

Inputs (8421 BCD)				**Outputs (GRAY)**			
A	B	**C**	**D**	**W**	**X**	**Y**	**Z**
0	0	0	0				
0	0	0	1				
0	0	1	0				
0	0	1	1				
0	1	0	0				
0	1	0	1				
0	1	1	0				
0	1	1	1				
1	0	0	0				
1	0	0	1				
1	0	1	0				
1	0	1	1				
1	1	0	0				
1	1	0	1				
1	1	1	0				
1	1	1	1				

[20]

QUESTION 5

Make a neat, labelled sketch of a D-type master/slave flip-flop which consists of NAND gates only. **[10]**

TOTAL: 100

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