higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

LOGIC SYSTEMS N4

(8080284)

6 December 2023 (X-paper)
09:00–12:00

Calculators may NOT be used. Drawing instruments may be used.

This question paper consists of 5 pages.

286Q1G2306

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

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QUESTION 1

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

1.2 Give the biggest symbol in the octal number system. (1)

1.3 How many flip-flops are needed in a shift register to store the number 11_{10} in binary? (1)

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

1.5 What do the following abbreviations stand for?

1.5.1 RAM

1.5.2 ROM

1.5.3 CD-RW

(3 × 1) (3)

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

1.7.2 $A(AB+C)$

1.7.3 $A\bar{A}+A\,A$

1.7.4 $AB+B\bar{C}+\bar{A}+1$

(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	Ø	Ø	Ø
01	1	Ø	Ø	Ø
11	1	1	Ø	Ø
10	1	1	0	0

1.8.2

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

1.8.3

CD \ AB	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 $75,25_{10} - 12,3_{8}$
Use two's complement subtraction.
Convert the final answer to the decimal system.

2.1.2 $53,5_{10} \times 1,3_{8}$
Convert the final answer to the hexadecimal system.

2.1.3 $A7,D_{16} \div 2,4_{8}$
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 ASCII code:

f A 5 T * (5)
[25]

QUESTION 3

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

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

3.1.2 $F=\overline{(A\oplus B\oplus C)\,(A+\overline{B}+C)}$

3.1.3 $F=\overline{(A+\overline{B}+C)+(A\overline{B}C)}\ \oplus\ \overline{A}\,\overline{B}$ (15)

3.2 Design a circuit that consists of NAND gates only, which will provide a binary 1 at the output when the majority of the three inputs A, B and C are at binary 1. Show the following:

3.2.1 The truth table (2)

3.2.2 The Boolean simplification (5)

3.2.3 The circuit diagram (3)

[25]

QUESTION 4

With the aid of Karnaugh maps, design a circuit that will convert the 8421 code with four variables (A, B, C, D) to the excess-3 code. Simplify with the aid of Boolean algebra so that the circuit consists of the minimum number of gates. **[20]**

QUESTION 5

Draw a neat, labelled sketch of a monostable multivibrator using NPN transistors. **[10]**

TOTAL: 100

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