higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T940**(E)**(A7)T

NATIONAL CERTIFICATE

LOGIC SYSTEMS N4

(8080284)

12 August 2019 (X-Paper)
09:00–12:00

This question paper consists of 5 pages.

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. Start each question on a NEW page.
4. Number the answers according to the numbering system used in this question paper.
5. ALL the sketches and diagrams must be large, clear and neat.
6. Keep questions and subsections of questions together.
7. Questions must be answered in BLUE or BLACK ink and drawings must be done in PENCIL.
8. Show ALL calculations.
9. Calculations and answers must be given in THREE fractional radix spaces, for example $10{,}101_2$
10. Work neatly and legibly.

QUESTION 1

1.1 Write down the symbols of the hexadecimal number system. (1)

1.2 What was the original function of the Gray code? (2)

1.3 Write down the name of a non-weighted, self-inverting code. (1)

1.4 State TWO main differences between *synchronous* and *asynchronous* counters. (2)

1.5 Simplify each of the following Boolean expressions:

1.5.1 $A\overline{B}+\overline{A}B$

1.5.2 $A(AB+C)$

1.5.3 $A\overline{A}+A\,A$

1.5.4 $AB+B\overline{C}+\overline{A}+1$

(4 × 1) (4)

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

1.6.1

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

1.6.2

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

1.6.3

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

(3 × 2) (6)

1.7 Draw the symbols of an SR master/slave flip-flop and clearly indicate the external connections necessary to make it toggle. (4)
[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 $34,6_8 - 38,875_{10}$. Use two's complement subtraction.
Convert the final answer to the hexadecimal system.

2.1.2 $12,1_8 \times 10,3_{10}$
Convert the final answer to the octal system.

2.1.3 $146,3_8 \div 23,C_{16}$
Convert the final answer to the decimal system

(3 × 6) (18)

2.2 Encode or decode the following numbers/codes:

2.2.1 The $8\overline{4}\overline{2}\overline{1}$ BCD code 100101111010 to its decimal equivalent. (3)

2.2.2 168 decimal to Gray code (4)
[25]

QUESTION 3

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

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

3.1.2 $F = \overline{AB \oplus \overline{BC} \oplus \overline{A\overline{B}C}}$

3.1.3 $F = (\overline{A}\overline{B}C + \overline{ABC}) + [A(\overline{\overline{BC}})]$

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

3.2.2 $F = \overline{\overline{(\overline{A}B + ABC)(\overline{A}BC + ABC)}\ \overline{(\overline{A}B + ABC)}}$

(2 × 5) (10)
[25]

QUESTION 4

Using J-K flip-flops, design a synchronous counter with outputs A, B and C to count the following binary sequence:

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

The sequence must repeat itself. Show the truth table, the Karnaugh maps and the counter circuit. **[20]**

QUESTION 5

Make a neat, labelled sketch of a basic BJT mono-stable multivibrator that uses NPN-transistors. **[10]**

TOTAL: 100