higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

LOGIC SYSTEMS N4

(8080284)

19 April 2021 (X-paper)
09:00–12:00

Calculators are not allowed.
Drawing instruments may be used.

This question paper consists of 5 pages.

245Q1A2119

Copyright reserved

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. Start each question on a new page.
5. Keep questions and subsections of questions together.
6. All sketches and diagrams must be large, clear and neat.
7. Show all calculations.
8. Give calculations and calculated answers with THREE fractional radix spaces, for example $10{,}101_2$.
9. Answer questions with a black or blue pen and make all drawings in pencil.
10. Write neatly and legibly.

Copyright reserved

QUESTION 1

1.1 State the purpose of Gray code. (1)

1.2 Write down the symbols of the octal number system. (1)

1.3 How many input combinations can be used on a three-input OR gate? (1)

1.4 Name ONE nonweighed inverting code. (1)

1.5 Which ONE of synchronous or asynchronous binary counters uses the output from the previous flip-flop to clock the next one? (1)

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

1.7 Explain the term small scale integration. (2)

1.8 Simplify each of the Boolean expressions:

1.8.1 $A + \overline{AB}$

1.8.2 $A + \overline{A}B + A$

1.8.3 $ABC + BC + A$

1.8.4 $\overline{ABC} + ABC + 0$

(4 × 1) (4)

1.9 Determine the simplest Boolean expression for each of the following Karnaugh maps. Redraw each Karnaugh map and show the groupings.

1.9.1

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

1.9.2

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

1.9.3

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

(3 × 2) (6)

[20]

QUESTION 2

2.1 Convert each of the following numbers to its binary equivalents and complete the calculations in the binary number system. Show all calculations.

2.1.1 $15{,}6_8 - 17{,}25_{10}$

Use one's complement subtraction. Convert the final answer to the hexadecimal system.

2.1.2 $AC{,}8_{16} \times 3{,}4_8$

Convert the final answer to the octal system.

2.1.3 $143{,}15_{10} \div 2{,}4_8$

Convert the final answer to the decimal system.

(3 × 6) (18)

2.2 Encode or decode each of the following numbers to the code as indicated:

2.2.1 213_{10} to Gray code (3)

2.2.2 01110110 7421 BCD code to the decimal equivalent (2)

2.2.3 35_{10} to Excessive 3 (XS 3) code (2)

[25]

QUESTION 3

3.1 Draw the circuit diagram of each of the following Boolean expressions. Do not change or simplify the expression.

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

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

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

(3 × 5) (15)

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

3.2.1 $F = \overline{(\bar{A}B + ABC)(\bar{A}BC + ABC)} \; \overline{(\bar{A}B + ABC)}$

3.2.2 $F = AB + \overline{\bar{A}B\bar{C} + A\bar{B} + \bar{A}C}$

(2 × 5) (10)

[25]

Copyright reserved

QUESTION 4

Use S-R flip-flops to design a synchronous counter with outputs A, B and C to count the following binary sequence:

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

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

QUESTION 5

The basic transistor circuit for an astable multivibrator produces a square wave output from a pair of grounded emitter cross-coupled transistors.

Draw the circuit diagram of a basic astable multivibrator circuit. **[10]**

TOTAL: 100

Copyright reserved