higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

LOGIC SYSTEMS N4

(8080284)

12 August 2021 (X-paper)
09:00–12:00

Calculators may NOT be used, but drawing instruments may be used.

This question paper consists of 6 pages.

292Q1G2112

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. 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 all drawings must be done with a pencil.
8. All calculations must be shown.
9. Calculations and calculated answers must be given in THREE fractional radix spaces, for example $10{,}101_2$.
10. Write neatly and legibly.

QUESTION 1

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

1.2 Give the truth table, the Boolean expression and the circuit symbol of a two-input NOR gate. (3)

1.3 Determine the one's complement of 10100111_2. (1)

1.4 Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'True' or 'False' next to the question number (1.4.1–1.4.5) in the ANSWER BOOK.

1.4.1 The amplitude and time remain constant in an analogue signal.

1.4.2 There is no steady state in a digital signal.

1.4.3 The contents of the non-volatile memory are erased when power is switched off.

1.4.4 An 'ON' state in a digital pulse can also be represented by a '1'.

1.4.5 One of the advantages of digital signals is that they can be transmitted over a long distance.

(5 × 1) (5)

1.5 Simplify the Boolean expressions below:

1.5.1 $(A+1)+B\bar{B}$

1.5.2 $\bar{A}+AB$

1.5.3 $A\bar{A}+B\bar{B}+1$

1.5.4 $\bar{A}+A.0$

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

1.6.2

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

1.6.3

CD \ AB	00	01	11	10
00	1	Ø	Ø	Ø
01	1	1	1	1
11	Ø	1	Ø	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 $13,35_{10} - 7,2_{8}$.

Use one's complement subtraction. Convert the final answer to the octal system. (6)

2.1.2 $183,65_{10} \times B,C_{16}$

Convert the final answer to the hexadecimal system. (6)

2.1.3 $651,3_{8} \div 6,75_{10}$

Convert the final answer to the decimal system. (6)

2.2 What does ASCII stand for? (2)

2.3 Encode the following into the ASCII code:

T u K s ! (5)
[25]

QUESTION 3

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

3.1.1 $F = \overline{A + \overline{B + \overline{C}} + ABC \oplus AB}$ (5)

3.1.2 $F = \overline{\overline{A}BCD + \overline{A}B\overline{C}\overline{D} + \overline{A}B}$ (5)

3.1.3 $F = (\overline{X + Y} + Z)(XY + \overline{XY})$ (5)

3.2 Design a circuit that consists of NAND gates only and 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 and the table below, design a circuit that will convert the 8421 BCD code with four variables (A, B, C, D) to 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 monostable multivibrator using NPN transistors. **[10]**

TOTAL: 100