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higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

LOGIC SYSTEMS N4

(8080284)

16 April 2020 (X-paper)
09:00–12:00

Calculators may not be used

This question paper consists of 5 pages.

282Q1A2016

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. Keep questions and subsections of questions together.
5. All drawings must be done in pencil and sketches and diagrams must be large, clear and neat.
6. Show all calculations.
7. Calculations and answers must be given in THREE fractional radix spaces, for example $10{,}101_2$
8. Work neatly.

QUESTION 1

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

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

1.3 Write down the biggest symbol in the hexadecimal number system. (1)

1.4 Determine the two's complement of 10110101_2 (2)

1.5 Which one of the SYNCHRONOUS or ASYNCHRONOUS binary counter uses the output from the previous flip-flop to clock the next one? (1)

1.6 How many select lines are needed for a 4:1 multiplexer? (1)

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

1.8 Explain *small scale integration*. (2)

1.9 Simplify each Boolean expression below.

1.9.1 $(A+\overline{A})+B\overline{B}$

1.9.2 $A\overline{C}+1+A$

1.9.3 $BCD+B+B\overline{C}\overline{D}$

1.9.4 $AB+AB\overline{A}$

(4 × 1) (4)

1.10 Determine the simplest Boolean expression for each Karnaugh map given below. Redraw each map in the ANSWER BOOK and show the groupings.

1.10.1

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

1.10.2

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

1.10.3

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

(3 × 2) (6)
[20]

QUESTION 2

2.1 Convert each of the numbers below to their BINARY equivalent and then complete the calculations in the binary number system. Show all conversions.

2.1.1 $B7,A_{16} - 73,6_{8}$.
Use two's complement subtraction. Convert the final answer to the octal system.

2.1.2 $213,45_{10} \times A,B_{16}$
Convert the final answer to the hexadecimal system.

2.1.3 $745,1_{8} \div 4,25_{10}$
Convert the final answer to the decimal system

(3 × 6) (18)

2.2 What does ASCII stand for? (2)

2.3 Encode the following in ASCII code:

S P a R ? (5)
[25]

QUESTION 3

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

3.1.1 $F=[(A \oplus B) \oplus \overline{C}]\overline{A}+(\overline{A}+\overline{B}+A\overline{C})$ (6)

3.1.2 $F=\overline{ABC}(\overline{\overline{A} \oplus \overline{BC}})$ (4)

3.1.3 $F=\overline{A\overline{B}+\overline{A+\overline{B}}+\overline{AB+C}}$ (5)

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

3.2.1 $F = A(\overline{A} + \overline{B} + C)(A + \overline{B} + C)(\overline{A} + B + \overline{C})$

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

(2 × 5) (10)
[25]

QUESTION 4

Use J-K flip-flops and design a synchronous counter with outputs A, B, C and D to count the binary sequence below. The sequence must repeat itself. Show the truth table, the Karnaugh maps and the counter circuit.

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