higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

DIGITAL ELECTRONICS N4

(8080354)

6 December 2023 (X-paper)
09:00–12:00

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

This question paper consists of 5 pages.

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DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
DIGITAL ELECTRONICS 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 drawings must be neat and well balanced.
5. Write neatly and legibly.

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QUESTION 1

Various options are given as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question number (1.1–1.5) in the ANSWER BOOK.

1.1 CMOS gates require a supply of between …

A 5 V and 10 V.
B 3 V and 18 V.
C 3 V and 10 V.
D 10 V and 18 V.

1.2 A half-adder adds decimal numbers up to …

A ½.
B 1.
C 2.
D 3.

1.3 SISO is the abbreviation for …

A set input, set output.
B set input, serial output.
C serial input, set output.
D serial input, serial output.

1.4 An exclusive OR gate gives a logic 1 output if …

A all the inputs are logic 1.
B one of the inputs is logic 1.
C both inputs are logic equal.
D all the inputs are logic 0.

1.5 A BCD counter counts up to …

A 9.
B 10.
C 15.
D 4.

(5 × 1) **[5]**

QUESTION 2

2.1 How many symbols are in a hexadecimal? (1)

2.2 What is the largest symbol in the octal number system? (1)

2.3 Calculate the following in the binary number system. Show all the conversions and calculations clearly.

2.3.1 $-12,5_8 - 12,5_{10}$
Use the 2's complement method and convert the final answer to the decimal system. (7)

2.3.2 A, $C_{16} \times 3,5_8$
Convert the final answer to the octal system. (6)

2.3.3 26, $F8_{16} \div 10.75_{10}$
Convert the final answer to the hexadecimal system. (7)

2.4 Write $47,5_{10}$ in the following binary codes:

2.4.1 2421 BCD (3)

2.4.2 Excess-3 BCD (3)

[28]

QUESTION 3

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

3.2 Draw a switching circuit of an equality comparator. (3)

3.3 Simplify each of the following Boolean expressions:

3.3.1 $ABC + AB\overline{C} + ABC + \overline{A}B = F$ (4)

3.3.2 $AB \oplus B = F$ (5)

3.3.3 $AB\overline{C} + A\overline{B}C + \overline{A}B\overline{C} + \overline{A}\overline{B}C = F$ (5)

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3.4 Draw the circuit diagrams of the Boolean expressions below. Do NOT change or simplify the expressions.

3.4.1 $\overline{\overline{(\overline{X}+\overline{Z})}+\overline{(\overline{Y}+Z)}}+F$ (4)

3.4.2 $\overline{\overline{\overline{X}\overline{Y}Z}+\overline{\overline{X}Y\overline{Z}}+\overline{X\overline{Y}\overline{Z}}+\overline{XYZ}}=F$ (7)

[29]

QUESTION 4

4.1 Discuss the difference between a *synchronous counter* and an *asynchronous counter*. (4)

4.2 Draw a neat, labelled diagram of a four-bit asynchronous binary up-counter and draw the timing diagram with TEN clock pulses. (10)

4.3 Draw the output wave form of the truth table below.

	J_A	A	B	C	D
1	0	0	0	0	0
2	1	1	0	0	0
3	0	0	1	0	0
4	0	0	0	1	0
5	0	0	0	0	1
6	0	0	0	0	0

(5)

[19]

QUESTION 5

5.1 Draw a neat diagram of a J-K master-slave flip-flop that makes use of NAND gates only. Show ALL input and output points. (8)

5.2 Briefly explain how the flip-flop in QUESTION 5.1 works. (8)

5.3 Draw a symbol of a 4 × 1 multiplexer. Show ALL inputs, outputs and control points. (3)

[19]

TOTAL: 100

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