higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T940**(E)**(A9)T

**NATIONAL CERTIFICATE**

# LOGIC SYSTEMS N4

(8080284)

**9 April 2018 (X-Paper)**
**09:00–12:00**

**Calculators may not be used.**

**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

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**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 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. Show ALL calculations.
9. Write neatly and legibly.

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## QUESTION 1

1.1 Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'true' or 'false' next to the question number (1.1.1–1.1.5) in the ANSWER BOOK.

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

1.1.2 There is no steady state in a digital signal.

1.1.3 The contents of nonvolatile memory are erased when the power is switched off.

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

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

(5 × 1) (5)

1.2 Define each of the following terms:

1.2.1 Boolean complement

1.2.2 Loading/Fan out

1.2.3 Noise immunity

1.2.4 Boolean variable

(4 × 2) (8)

1.3 Write the two's complement for $110111,01_2$. (1)

1.4 Digital signals are sometimes denoted by square waves and can be used as clock pulses for digital circuits.

Draw a square wave showing the mark period, the space period, the leading edge and the trailing edge. (4)

1.5 Digital systems use a unique number system for operation and communication.

Give the name and the base of this number system. (2)

**[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 Use the one's complement method to subtract $9,25_{10}$ from $6,5_8$.

Convert the final answer to the decimal system.

2.1.2 $13,5_8 \times 5,25_{10}$

Convert the final answer to the octal system.

2.1.3 $14,75_{10} \div 6,4_8$

Convert the final answer to the octal system.

(3 × 6) (18)

2.2 Convert $5,35_{10}$ to the following BCD codes:

2.2.1 8421 BCD

2.2.2 2421 BCD

(2 × 3) (6)

2.3 The message, '#LOGIC', is to be sent by means of a data line. The system uses ASCII code.

Write down the ASCII of this message. (6)

**[30]**

## QUESTION 3

3.1 Sketch the circuit diagram of the given Boolean expression. Do NOT change or simplify the expression:

$$f = (\overline{A} \oplus \overline{B})\ \overline{(A \oplus B)}C + (A + \overline{B} + AC)$$ (7)

3.2 An inequality comparator can be designed by using only four NAND gates.

Use Boolean algebra to show how it is possible to implement an inequality comparator that uses FOUR NAND gates.

Clearly show the following:

3.2.1 Truth table (1)

3.2.2 Boolean algebra (6)

 

3.2.3 De Morgan's theorem application (2)

3.2.4 Gate circuit (4)

**[20]**

**QUESTION 4**

Your company experiences a challenge in transmitting a signal that is coded by the 8421 code.

Design a code converter circuit that will convert the 8421 BCD code (A, B, C and D) to the 2421 BCD code (F1, F2, F3 and F4). Use Karnaugh maps and show the conversion to NAND gates. Draw the circuit diagram by using NAND gates only. **[20]**

**QUESTION 5**

Draw a neat, labelled sketch of an RS master-slave flip-flop which consists of NAND gates only. Show the IEC symbol. **[10]**

**TOTAL: 100**