higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T340**(E)**(N28)T

NOVEMBER EXAMINATION

NATIONAL CERTIFICATE

DIGITAL ELECTRONICS N4

(8080354)

28 November 2016 (X-Paper)
09:00–12:00

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. Keep subsections of questions together.
5. Rough calculations may be done at the back of the ANSWER BOOK.
6. Write neatly and legibly.

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QUESTION 1

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

1.2 Give the biggest symbol of the decimal number system. (1)

1.3 What was the original function of the Gray code? (2)

1.4 Write down the name of a non-weighed, self-inverting code. (1)

1.5 Determine the one's complement of $1001{,}101_2$ (1)

1.6 Give the symbol, truth table and Boolean expression for an exclusive OR gate. (3)

1.7 Write down the simplest form of the Boolean expressions below:

1.7.1 $1 + \overline{A}B + \overline{A + B}$

1.7.2 $\overline{A}A + A\overline{B} + B\overline{B}$

1.7.3 $\overline{A} + A\overline{B} + B$

1.7.4 $A\overline{A} + 1 + \overline{B}B + \overline{\overline{C}C}$

(4 × 1) (4)

1.8 State TWO main differences between *synchronous* and *asynchronous* counters. (2)

1.9 Draw the symbols of the following master/slave flip-flops and clearly indicate the external connections necessary to make each one toggle.

1.9.1 RS

1.9.2 JK

1.9.3 D-type

(3 × 3) (9)

[24]

QUESTION 2

2.1 Do the following calculations in the binary number system. Show ALL conversions and calculations clearly:

2.1.1 $14{,}5_8 - E{,}6_{16}$

Make use of the one's complement method and convert the final answer to the decimal number system.

2.1.2 $2C{,}5_{16} \div 6{,}25_{10}$

Convert the final answer to the octal number system.

2.1.3 $12{,}125_{10} \times 5{,}4_8$

Convert the final answer to the octal number system.

(3 × 6) (18)

2.2 Draw a binary table to show the operation of a half-adder. (2)

2.3 Write $47{,}9_{10}$ in the following codes:

2.3.1 2421-BCD

2.3.2 Excess-3 BCD

(2 × 3) (6)
[26]

QUESTION 3

3.1 Draw the circuit diagram of the Boolean expression below without changing or simplifying it:

$\overline{\overline{A\overline{B}} + \overline{\overline{A}B} + C + \overline{B\overline{C}}}$ = F (6)

3.2 De Morgan developed a method of replacing different gates with NAND gates as building blocks. Simplify the Boolean expressions below by using Boolean algebra. Then draw the circuit diagrams by using only NAND gates.

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

3.2.2 $\overline{\overline{(AB\overline{C} + ABC)}\,\overline{(\overline{A}BC + A\overline{B}C)}} = F$

(2 × 6) (12)
[18]

QUESTION 4

4.1 Design a 4-bit parallel-in/parallel-out shift register using D-type flip-flops. (5)

4.2 Draw a 4-bit synchronous binary up-counter using JK master/slave flip-flops and AND gates. Show the output count waveforms for ten clock pulses. (12)
[17]

QUESTION 5

Make a neat labelled sketch of a D-type master/slave flip-flop which consists of only NAND gates.

Draw the input clock-pulse waveform and indicate the four most significant switching points on the waveform.

Explain the switching sequence for each point indicated on the waveform. **[15]**

TOTAL: 100

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