higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T400**(E)**(A8)T

APRIL EXAMINATION

NATIONAL CERTIFICATE

DIGITAL ELECTRONICS N4

(8080354)

8 April 2016 (X-Paper)
13:00–16:00

Calculators may not be used.

This question paper consists of 5 pages.

DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
DIGITAL ELECTRONICS N4
TIME: 4 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 calculations must be clearly shown.
5. ALL sketches and diagrams must be neat and labelled.
6. Write neatly and legibly.

QUESTION 1

1.1 Computers use a unique number system for operation.

List the name and radix of this number system. (2)

1.2 Write the symbols of the Hexadecimal number system. (1)

1.3 How many input combinations can be used on a FOUR input AND gate? (1)

1.4 Name any non-weighed BINARY code. (1)

1.5 Give the symbol, truth table and Boolean expression of the (3) NAND gate. (3)

1.6 Write the simplest form of the Boolean expressions below:

1.6.1 $ABC + AB\overline{C} + 1 =$

1.6.2 $A + BCD + \overline{A} + CD =$

1.6.3 $A\overline{B} + A.\overline{B}.\overline{C} + \overline{B} =$

1.6.4 $ABC + \overline{ABC} + BC =$

(4 × 1) (4)

1.7 Describe the term *fan out* as applicable to digital circuits. (3)

1.8 Convert $110111{,}01_2$ binary to the Gray code. (2)

1.9 Write the TWO'S compliment for: $110111{,}01_{2.}$ (1)

1.10 Square waves are used as clock pulses for digital circuits.

Use a clear sketch to show the following points on a square wave:

1.10.1 Mark period

1.10.2 Space period

1.10.3 Leading edge

1.10.4 Trailing edge

(4 × 1) (4)

[22]

QUESTION 2

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

2.1.1 $14{,}5_8 - 14{,}375_{10}$

Use the ONE'S compliment method and convert the final answer to the DECIMAL system. (6)

2.1.2 $14{,}5_{10} \times 5{,}4_8$

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

2.1.3 $16{,}4_8 \div 6{,}5_{10}$

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

2.2 Convert $6{,}45_{10}$ to the following BCD codes:

2.2.1 2421 BCD

2.2.2 8421 BCD

2.2.3 Excess-3 BCD

(3 × 3) (9)
[27]

QUESTION 3

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

3.1.1 $(A + \overline{B + AC})(A\overline{B} + \overline{BC + A}) = F$

3.1.2 $(A \oplus \overline{B + C})(A + \overline{B \oplus C} + BC) = F$

(2 × 6) (12)

3.2 Your company needs a circuit which will only supply a binary 1 at the output if there are an uneven number of zeroes at the inputs A, B and C. You may only use two exclusive gates. Use Boolean algebra to design this circuit. Show the following clearly:

3.2.1 Truth table (1)

3.2.2 Boolean algebra (7)

3.2.3 Circuit diagram (2)
[22]

QUESTION 4

4.1 Make a neat labelled sketch of a series BCD adder. Use the BCD values of 3_{10} and 6_{10} to illustrate the working of this adder. (9)

4.2 Draw the circuit diagram of a 4-bit asynchronous binary up counter. Use JK Master-slave flip-flops in your design.

Show ALL the input-, output and control points clearly. (6)
[15]

QUESTION 5

Make a neat labelled sketch of a JK Master-slave flip-flop, which is built from NAND gates only. Give the state transition table for this flip-flop and also indicate the status of the master and slave sections of this flip-flop during the four most important sections on the input clock pulse. **[14]**

TOTAL: 100