higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T390(E)(N11)T

NOVEMBER EXAMINATION

NATIONAL CERTIFICATE

DIGITAL ELECTRONICS N4

(8080354)

11 November 2014 (Y-Paper)
13:00–16:00

Calculators are NOT allowed.

This question paper consists of 5 pages.

ENGINEERING

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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 calculations must be clearly shown.
5. ALL sketches and diagrams must be neat and fully labelled.
6. Write neatly and legibly.

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QUESTION 1

1.1 Write down the symbols of the DECIMAL system, (1)

1.2 Write down the symbols of the OCTAL system. (1)

1.3 How many input combinations can be used on a TWO input OR gate? (1)

1.4 Name any weighed self-inverting code. (1)

1.5 Give the symbol, Truth Table and Boole expression of the NAND gate. (3)

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

1.6.1 $X + \overline{XY} = F$

1.6.2 $X + \overline{X}Y + X = F$

1.6.3 $XYZ + YZ + X = F$

1.6.4 $\overline{XYZ} + XYZ + 0 = F$

(4 x 1) (4)

1.7 Which device (system) is used by Telkom to combine many telephone calls on a single line? (1)

1.8 Convert 110111_{gray} to the BINARY code. Show the method of conversion that you have used. (2)

1.9 Draw the Truth Table for a half adder. (2)

1.10 Explain what is meant by the term *fan out* in electronics. (2)

1.11 Write down the Boole expressions for De Morgan's TWO theorems. (2)
[20]

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QUESTION 2

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

2.1.1 2.1.1 $15,6_8 - 17,25_{10}$

Use the one's compliment method and convert the final answer to the DECIMAL system.

2.1.2 2.1.2 $E,5_{16} \times 2,375_{10}$

Convert the final answer to the HEXADECIMAL system.

2.1.3 $A,C_{16} \div 2,3_8$

Convert the final answer to the OCTAL system.

(3 x 6) (18)

2.2 Write $3,79_{10}$ in the following BINARY codes:

2.2.1 8421 BCD

2.2.2 2421 BCD

2.2.3 Excess-3 BCD

(3 x 3) (9)
[27]

QUESTION 3

3.1 Draw the circuit diagrams of the Boole equations below. Do NOT change or simplify the equations:

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

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

3.1.3 $\overline{(ABC+\overline{ABC})(A+BC)} = F$

(3 x 5) (15)

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3.2 Simplify the expression below with Boolean algebra.

Draw the simplified circuits using ONLY NAND gates

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

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

(2 x 6) (12)
[27]

QUESTION 4

4.1 Draw the circuit diagram of a four–bit ASYNCHRONOUS binary UP counter. Show ALL control and input/output points.

Draw the clock pulse and count waveforms for TEN clock pulses. (8)

4.2 Make a neat, labelled sketch of a 3-bit JOHNSON counter. Use JK master-slave flip flops.

Draw the timing diagram for SIX clock pulses. (8)
[16]

QUESTION 5

Make a neat sketch of a D-type master-slave flip flop consisting of only NAND gates.

Briefly describe the FOUR most important switching points on the input clock pulse. **[10]**

TOTAL: 100

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MARKING GUIDELINE

NATIONAL CERTIFICATE

NOVEMBER EXAMINATION

DIGITAL ELECTRONICS N4

11 NOVEMBER 2014

This marking guideline consists of 7 pages.

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QUESTION 1 / VRAAG 1

1.1 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 ✓

1.2 0, 1, 2, 3, 4, 5, 6, 7 ✓

1.3 $2^2 = 4$ ✓

1.4 2421 / AIKEN ✓

1.5 

✓

A	B	Q
0	0	1
0	1	1
1	0	1
1	1	0

✓ $Q = \overline{A \cdot B}$ ✓

1.6.

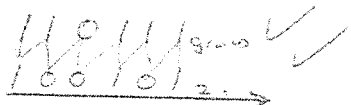
1.6.1 1 ✓

1.6.2 $x + y$ ✓

1.6.3 $x + yz$ ✓

1.6.4 1 ✓

1.7 MULTIPLEXER / DEMULTIPLEXER. ✓
MULTIPLEKSER / DE-MULTIPLEKSER.

1.8 

✓ ✓

1.9

A + B	S_0	C_0
0 0	0	0
0 1	1	0
1 0	1	0
1 1	0	1

✓ ✓

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2.

1.10. Refers to the maximum number of inputs that can reliably be driven by an output without giving a false reading.
Verwys na die maksimum getal insette wat betroubaar gedryf kan word deur 'n uitset sonder in vals lesing.

1.11
(i) $\overline{A\,B} = \bar{A} + \bar{B}$
(ii) $\bar{A}\,\bar{B} = \overline{A + B}$

[20]

VRAAG 2 / QUESTION 2.

2.1

2.1.1 $15,6_{10} = 1101,110_2$ → 1's C $00110001,11$
$17,25_{10} = 10001,01_2$ → $\underline{+\ 10111010}$
$11111100,01 = -11_2$
$= -3,5_{10}$ (6)

No Carry.
1's Compliment for answer
Sign negative.

2.1.2 $E,5_{16} = 1110,0101_2$
$2,375_{10} = 10,011_2$

$1110,0101_2 \times 10011_2$
11100101
111001010
1110010100
$100001,11111_2$
$= 21,FE_{16}$ (6)

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2.1.3 $A_1C_{16} = 1010,1100$ ✓
$2,3_8 = 10,011$ ✓

100,1000
10011 | 1010 1100,0000
1001 1
0001 0100
10011
0000 1000

100,1000 = 4,4 ✓ (6)

2.2. $3,79_{10}$

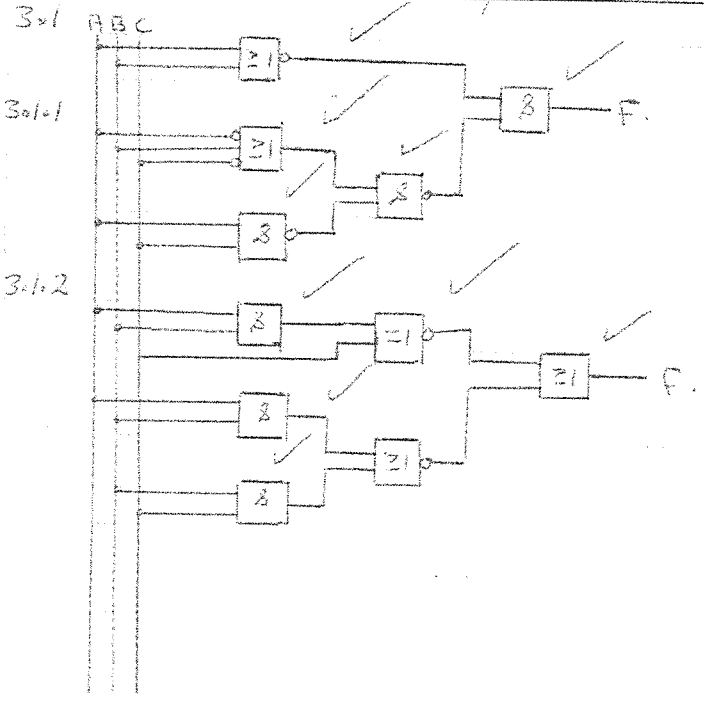
2.2.1 $0011,0111\ 1001_{3421}$ ✓ ✓ ✓ (3)

2.2.2 $0011,1101\ 1111_{2421}$ ✓ ✓ ✓ (3)

2.2.3 $0110,1010\ 1100_{XS3}$ ✓ ✓ ✓ (3) [27]

QUESTION 3 / VRAAG 3

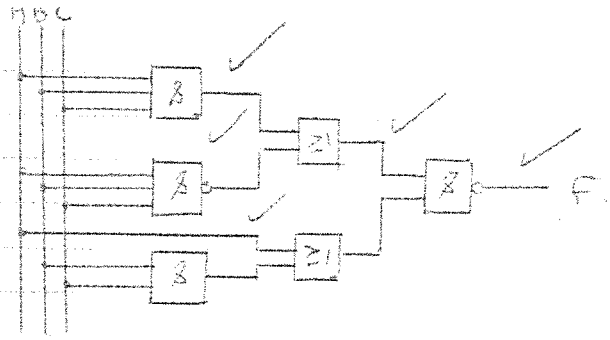
3.1 A B C



3.1.1 (5)

3.1.2 (5)

3.1.3



(5)

3.2

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

$=(A+AB+AC)(\bar{B}+\bar{C})(\bar{A}+B+C)$ ✓

$=A(\bar{B}+\bar{C})(\bar{A}+B+C)$

$=(A\bar{B}+A\bar{C})(\bar{A}+B+C)$ ✓

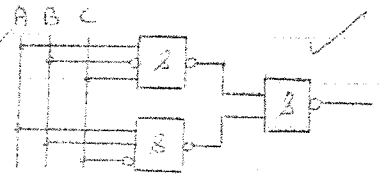
$=0+0+A\bar{B}C+0+AB\bar{C}+0$ ✓

$=A\bar{B}C+AB\bar{C}$ ✓

TO NANDS:

$\overline{A\bar{B}C+AB\bar{C}}$ ✓

$=\overline{A\bar{B}C}\cdot\overline{AB\bar{C}}$



(6)

3.2.2.

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

$=AB+(\overline{\bar{A}B\bar{C}}\cdot\overline{A\bar{B}}\cdot\overline{\bar{A}C})$ ✓

$=AB+(\bar{A}+\bar{B}+\bar{C})(\bar{A}+\bar{B})(\bar{A}+\bar{C})$

$=AB+(A+\bar{B}+C)(\bar{A}+B)(A+\bar{C})$ ✓

$=AB+(0+AB+\bar{A}\bar{B}+0+\bar{A}\bar{C}+BC)(A+\bar{C})$

$=AB+(AB+\bar{A}\bar{B}+\bar{A}\bar{C}+BC)(A+\bar{C})$ ✓

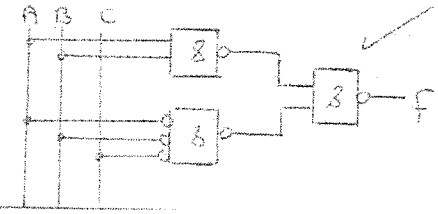
$=AB+AB+0+0+ABC+AB\bar{C}+\bar{A}\bar{B}\bar{C}+0+0$

$=AB+\bar{A}\bar{B}\bar{C}$ ✓

TO NANDS.

$\overline{AB+\bar{A}\bar{B}\bar{C}}$ ✓

$=\overline{AB}\cdot\overline{\bar{A}\bar{B}\bar{C}}$

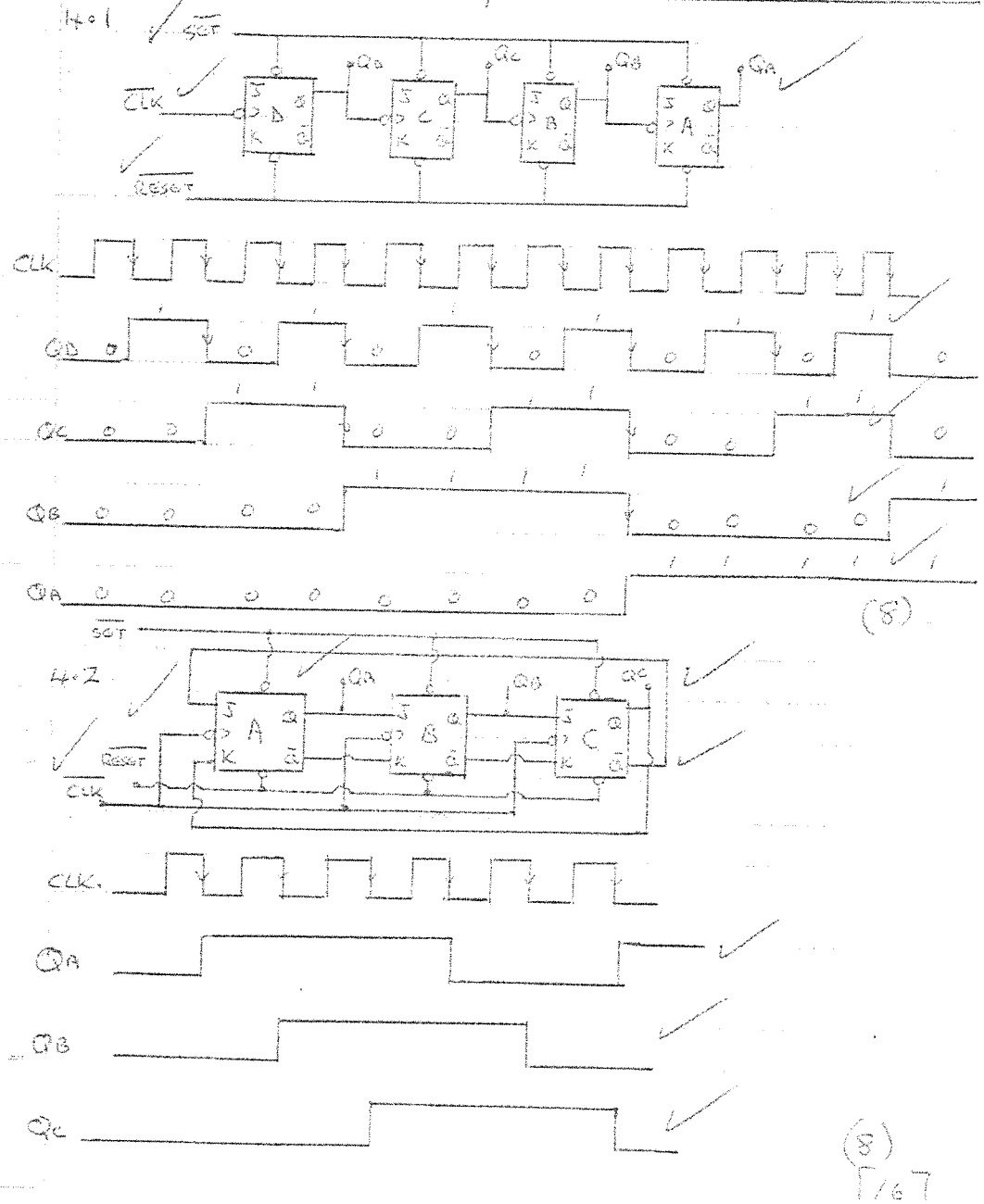


(6)

[27]

VRAAG 4 / QUESTION 4.

4.1

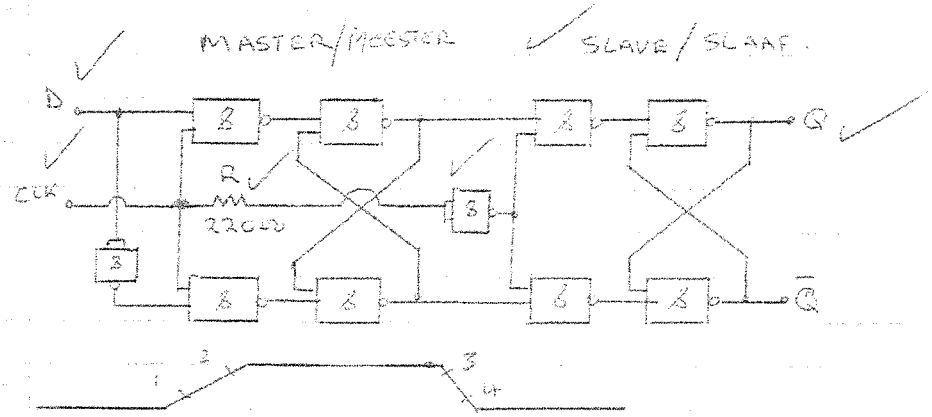


(8)

(8)

[16]

QUESTION 5 / VRAAG 5



1. Master Closed. Slave Closed. ✓
   Meester toe Slaaf toe.

2. Master Open Slave Closed ✓
   Meester oop Slaaf Toe.

3. Master Closed Slave Closed. ✓
   Meester Toe Slaaf toe

4. Master Closed Slave Open. ✓
   Meester toe Slaaf Oop.

(10)

TOTAL: [100]
TOTAAL

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