higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

DIGITAL ELECTRONICS N4

(8080354)

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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. Read all the questions carefully.
2. Answer all the questions.
3. Number the answers according to the numbering system used in this question paper.
4. Start each question on a new page.
5. Write neatly and legibly.

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QUESTION 1

1.1 Various options are given as possible answers to the following questions. Choose the answer by applying the laws and identities of Boolean algebra, and write only the letter (A–D) next to the question number (1.1.1–1.1.5) in the ANSWER BOOK.

1.1.1 $(A + B)(A + C)$

A 1
B A
C AB
D A + BC

1.1.2 $A + A\overline{B}$

A AB
B A + B
C A $\overline{\ }$
D A + $\overline{B}$

1.1.3 $\overline{A}A + \overline{A}B$

A 0
B 1
C AB
D $\overline{A}B$

1.1.4 $\overline{\overline{A} + \overline{A}}$

A A
B 0
C 1
D $\overline{A}$

1.1.5 $A + AB + ABC + 1$

A B
B AB
C 1
D A

(5 × 1) (5)

1.2 Complete the following sentences by writing down the missing word or words next to the question number (1.2.1–1.2.5) in the ANSWER BOOK.

1.2.1 For an SR latch using NOR gates the circuit switches on a … going pulse.

1.2.2 The full adder has two outputs: sum and …

1.2.3 In synchronous clocking flip-flops are clocked ….

1.2.4 The JK inputs are connected to a logic 1 to keep them in a … mode.

1.2.5 To design a module 30 counter, module 2, 3 and … must be coupled in series.

(5 × 1) (5)

1.3 Choose a term from COLUMN B that matches a description in COLUMN A. Write only the letter (A–E) next to the question number (1.3.1–1.3.5) in the ANSWER BOOK.

COLUMN A		COLUMN B	
1.3.1	Period that amplitude of square wave remains equal to or above 90% of the final maximum value	A	switch-on time
1.3.2	Period that amplitude of square wave remains below or equal to 10% of the maximum amplitude value after switching on has occurred	B	noise immunity
1.3.3	Delay time plus rise time of square wave pulse	C	delay time
1.3.4	Measurement of how much noise digital IC can withstand without false change in output	D	flip-flops
1.3.5	Bistable multivibrators with memory characteristics	E	pulse time

(5 × 1) (5)

1.4 Indicate whether the following statements are TRUE or FALSE by writing only 'True' or 'False' next to the question number (1.4.1–1.4.5) in the ANSWER BOOK.

1.4.1 The 2421 code is a self-complementing code.

1.4.2 The hamming code is an error detection code.

1.4.3 FOUR flip-flops are needed to count down from 18 to zero.

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1.4.4 Fan-out is the amount of logic gates present in a single chip.

1.4.5 The CPU consists of the arithmetic logic unit and the control unit.

(5 × 1) (5)

1.5 Choose ONE term from the list below for each of the following descriptions. Write only the term next to the question number (1.5.1–1.5.5) in the ANSWER BOOK.

nonweighted; fan-out; latch; multivibrator; bit

1.5.1 Smallest unit of data

1.5.2 Electronic circuit used to implement a variety of simple two-state devices such as timers and flip-flops

1.5.3 Circuit with two stable states used to store state information

1.5.4 Reliability of loading factor of an IC device

1.5.5 Code in which a fixed value is not allocated to each bit position

(5 × 1) (5)

1.6 Choose the correct term from those in brackets. Write only the term next to the question number (1.6.1–1.6.5) in the ANSWER BOOK.

1.6.1 The (full/half) adder is used to add three variables A, B and C.

1.6.2 A (shift register/decoder) converts binary to decimal equivalents.

1.6.3 An intersection of two variables is known as a (maximum/minimum) term.

1.6.4 The exclusive (OR/NOR) function is also known as the equality comparator.

1.6.5 The (8421/excess-3) code is a self-complementing code.

(5 × 1) (5)

[30]

QUESTION 2

2.1 Subtract each of the following by means of the one's complement and convert the final answer to the decimal system:

2.1.1 $-58,75_{10} - 46,5_{10}$ (6)

2.1.2 $C, A_{16} - 7, B_{16}$ (6)

2.2 Calculate the following in their binary form and convert the final answer to the decimal system:

2.2.1 $6A,5_{16} \div 3,7_{8}$ (6)

2.2.2 $6D, A_{16} \times 55,5_{8}$ (6)

2.3 Convert the following codes as indicated:

2.3.1 101101_{2} to Gray

2.3.2 $28,4_{10}$ to XS3

2.3.3 $2A, F8_{16}$ to binary

(3 × 2) (6)

[30]

QUESTION 3

3.1 Simplify the following Boolean expression:

3.1.1 $F = X\,(X + Y)\,(\overline{X} + \overline{Y} + Z)$ (6)

3.1.2 $F = (\overline{A\,\overline{A}\,\overline{B}})\,(\overline{B\,\overline{A}\,\overline{B}})$ (4)

3.2 Draw the logic circuit for the following Boolean expression without simplifying:

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

(6)

[16]

QUESTION 4

Make a neat sketch of the following circuit diagrams:

4.1 4-bit JK shift register (right shift) (6)

4.2 Synchronous up-counter (8)
[14]

QUESTION 5

Draw the block diagram of each of the following A/D converters:

5.1 Successive approximation (5)

5.2 Ramp type (5)
[10]

TOTAL: 100

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