higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T480**(E)**(J31)T

NATIONAL CERTIFICATE

DIGITAL ELECTRONICS N6

(8080376)

31 July 2019 (X-Paper)
09:00–12:00

Nonprogrammable calculators may be used.

This question paper consists of 9 pages.

DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
DIGITAL ELECTRONICS N6
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. Write neatly and legibly.

QUESTION 1: COMPUTER SYSTEMS

1.1 Various options are given as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question number (1.1.1–1.1.4) in the ANSWER BOOK.

1.1.1 Device that connects the outside world to the binary world of computers:

A Modem
B Multiplexer
C Demultiplexer
D Analogue-to-digital converter

1.1.2 The following transducer is a semi-conductor of which the resistance varies with temperature:

A Thermistor
B Thermocouple
C Thermometer
D Photo-diode

1.1.3 Smallest input change that can cause a change in output:

A Resolution
B Conversion time
C Settling time
D Quantising error

1.1.4 Code that helps prevent glitches (incorrect voltages) in counters:

A Binary-coded decimal
B Boolean code
C Gray code
D Hamming code

(4 × 1) (4)

1.2 Indicate whether the following statements are TRUE or FALSE. Choose the answer and write 'True' or 'False' next to the question number (1.2.1–1.2.4) in the ANSWER BOOK.

1.2.1 A PTC thermistor experiences an increase in resistance when the ambient temperature increases.

1.2.2 The micro-instruction unit that distributes the pulses in a computer control unit is a demultiplexer.

1.2.3 A decoder in a computer control unit decodes the operational code.

1.2.4 A feasibility study is conducted and led by a computer operator.

(4 × 1) (4)

1.3 Choose a term from COLUMN B that matches the description in COLUMN A. Write only the letter (A–F) next to the question number (1.3.1–1.3.4) in the ANSWER BOOK.

COLUMN A		COLUMN B	
1.3.1	High-level engineering program	A	compiler
1.3.2	High-level business program	B	flow chart
1.3.3	Low-level program using mnemonics	C	assembly
		D	fortran
1.3.4	Graphical representation of a program	E	basic
		F	cobol

(4 × 1) (4)

1.4 Draw a simple diagram of a thermocouple and briefly describe its operation. (4)

1.5 A multiplexer (mux) is a versatile piece of hardware.

Name FOUR other applications it can serve in a digital system apart from multiplexing. (4)

[20]

QUESTION 2: TRANSMISSION, DATA ACQUISTION AND RELATED HARDWARE

2.1 Various options are given as possible answers to the following questions. Choose the answer and write only the letter (A-D) next to the question number (2.1.1–2.1.4) in the ANSWER BOOK.

2.1.1 Frequency shifted keying is generated by the following device:

A Modem
B Multiplexer
C Demultiplexer
D Analogue-to-digital converter

2.1.2 The interface that converts parallel data into serial data and vice-versa:

A Transducer
B Thermocouple
C UART
D Modem

2.1.3 Which ONE of the following is a widely used operating system?

A Windows
B Firefox
C Apple
D Google

2.1.4 If a 10-bit DAC has a step size of 1 mV, what will its full-scale voltage be?

A 2,047 V
B 1,023 V
C 0,511 V
D 0,256 V

(4 × 1) (4)

2.2 Indicate whether the following statements are TRUE or FALSE. Choose the answer and write 'True' or 'False' next to the question number (2.2.1–2.2.4) in the ANSWER BOOK.

2.2.1 If a computer is off-line it means that it is switched off.

2.2.2 NRZ transmission means that the coded signal returns to zero between bits.

2.2.3 In a PCM system a 1 is represented by +5V.

2.2.4 The 8.4.2.1 code is commonly used as an error detecting code.

(4 × 1) (4)

2.3 Choose a term from COLUMN B that matches the description in COLUMN A. Write only the letter (A–F) next to the question number (2.3.1–2.3.4) in the ANSWER BOOK.

COLUMN A		COLUMN B	
2.3.1	Problem which must be attended to immediately	A	internal interrupt
2.3.2	Problems ranked in a preset order	B	external interrupt
2.3.3	Problem that originates from outside the computer	C	priority interrupt
2.3.4	Problem that is detected within a computer	D	maskable interrupt
		E	nonmaskable interrupt
		F	vectored interrupt

(4 × 1) (4)

2.4 Draw a neat, labelled block diagram of a modem. (4)

2.5 A PCM system is to transmit the following packages using RZ (return to zero):

1000 1110 1100 0110

Use ALL FOUR bits in the string and graphically show how the transmission would look. (4)

[20]

QUESTION 3: COMPUTER ARCHITECTURE

Base the answers for the question below on the Von Neumann Architecture where a common RAM holds all data and program instructions, necessitating a fetch and an execute routine.

3.1 Draw a neat, fully labelled block diagram of a control with a six-bit ring counter that drives the instruction unit. Do-nothing-phases are possible because of this arrangement. Show ALL interconnections and gates that link the PC, IR, ALU, MAR, RAM and MBR to one another. (10)

3.2 Use the following table to show what happens after each pulse from the micro-instruction unit in QUESTION 3.1 above. Clearly separate each micro-instruction from the next and show how the micro-instructions are grouped into routines.

Use block diagrams or descriptions or both to show what happens when the control unit receives the instruction to load a number into the accumulator.

INSTRUCTION LOCATION	INSTRUCTION WORD	DESCRIPTION
1110	0000 1110	The contents of address 1110 is 0001 0001. This must be loaded into the accumulator

(10)
[20]

QUESTION 4: HIGH-LEVEL PROGRAMMING

4.1 Consider the following FORTRAN program segment:

```
        MUMFORD = 14
        SONS = 9
21100   ANSWER = MUMFORD + SONS
        SONS = SONS + 7
        IF (ANSWER.LT.40) GO TO 21100
        SONS = SONS + 7
        PRINT, ANSWER, MUMFORD, SONS
        STOP
        END
```

Draw a table with the following headings: PASS, MUMFORD, SONS and ANSWER. Clearly show how each value changes with each successive pass. Show what the final printout will look like underneath the table. (10)

4.2 What is the difference between a *bug* and a *virus* in a program? (2)

4.3 The following is a schematic drawing of a stack with its contents.

Redraw the stack and the stack pointer to show what the contents would look like if the number $F2_{16}$ is pushed onto the stack.

Stack pointer
09

Stack

Address	Contents
07	60_{16}
08	32_{16}
09	81_{16}

(3)

4.4 Below is a section of a program in machine code.

INSTRUCTION	OP CODE	ADDRESS	DESCRIPTION
0000	0011	1001	LOAD ACCUMULATOR
0001	0111	1010	ADD
0010	0111	1101	ADD
0011	0110	1100	SUB
0100	0111	1011	ADD

The following are the address contents to which the program above refers:

ADDRESS	ADDRESS CONTENTS
1001	33_{16}
1010	44_{16}
1011	11_{16}
1100	77_{16}
1101	88_{16}

Rewrite each instruction number below one another and next to it clearly show the accumulator contents after each instruction. (5)
[20]

QUESTION 5: NUMBER SYSTEMS

5.1 The following word is received in Hamming Code.

Find the fault in the word showing ALL the steps. Clearly state the bit number on which the fault lies and then rewrite the correct word indicating which bit has been corrected.

$0111111111_{hamming}$ (10)

5.2 Write the following floating point number in decimal, showing ALL the steps:

0 111 0 01111010 (3)

5.3 Rewrite the following binary-coded decimal (8.4.2.1) in the XS-3 code:

$1001\ 0010\ 0110_{8.4.2.1}$ (3)

5.4 Rewrite the following Gray code number in binary:

1000111_{gray} (2)

5.5 Using the variables D, E and F write down the general rule for the distributive law in Boolean algebra. (2)

[20]

TOTAL: 100