



higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
DIGITAL ELECTRONICS N6

(8080376)

29 July 2021 (X-paper)
09:00–12:00

Drawing instruments may be used.

This question paper consists of 8 pages.

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DEPARTMENT OF HIGHER EDUCATION AND TRAINING
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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. Start each section on a new page.
 5. Only use a black or blue pen.
 6. Write neatly and legibly.
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SECTION A**QUESTION 1**

Choose the correct term from those in brackets. Write only the answer next to the question number (1.1–1.5) in the ANSWER BOOK.

- 1.1 A (synchronous/asynchronous) system is one that requires no 'start' and 'stop' bits.
- 1.2 An interface that converts parallel data into serial data and vice versa is called a (UART/modem).
- 1.3 Frequency shifted keying is generated by a (multiplexer/modem).
- 1.4 The (data/address) bus is a unidirectional bus.
- 1.5 A (server/inverter) is the interface between a computer and the internet.

(5 × 1)

[5]**QUESTION 2**

Choose ONE term from the list below for each of the following descriptions and write it next to the question number (2.1–2.5) in the ANSWER BOOK.

OR gate; AND gate; XOR gate; XNOR gate; binary; solar flare; handshaking;
Hamming code; 8.4.2.1 code; XS-3 code

- 2.1 The process of synchronising modems
- 2.2 A source of transmission noise
- 2.3 Integrated circuit used for detecting even parity
- 2.4 Integrated circuit used for detecting odd parity
- 2.5 An error detection code

(5 × 1)

[5]

QUESTION 3

Indicate whether the following statements are TRUE or FALSE by writing only 'True' or 'False' next to the question number (3.1–3.5) in the ANSWER BOOK.

- 3.1 In a PCM system a '0' is represented by +5V.
- 3.2 Boolean algebra is used to simplify gate circuits.
- 3.3 Modem tones are audible (can be heard by the human ear).
- 3.4 NRZ transmission means that the coded signal returns to zero between bits.
- 3.5 An anti-virus program detects an unexpected file extension. (5 × 1) **[5]**

QUESTION 4

Complete the following paragraph by writing only the missing word or words next to the question number (4.1–4.5) in the ANSWER BOOK.

Computer languages that use instructions that look like English words are referred to as (4.1) ... An example of this would be (4.2) ... The computer itself converts these languages into (4.3) ... that consists of ones and zeroes. The computer can do this by either (4.4) ... the program, which makes the program slow but easy to debug, or by (4.5) ... the program, which speeds the program up but makes debugging more difficult.

(5 × 1) **[5]**

QUESTION 5

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 (5.1–5.5) in the ANSWER BOOK.

5.1 The time lapse between the application of an input and the output reaching a specified point of its final value:

- A Quantising time
- B Settling time
- C Conversion time
- D Resolution time

5.2 The number of operations a digital device can carry out:

- A Percentage resolution
- B Instruction repertoire
- C Branch instruction
- D Logical operation

5.3 The Boolean expression $B + ABC$ can be simplified as ...

- A ABC .
- B B .
- C $A + BC$.
- D $BC + A$.

5.4 A device that has several data inputs but allows them only to appear one at a time sequentially at the output:

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

5.5 This transducer relies on the Seebeck effect:

- A Thermistor
- B Thermostat
- C Thermometer
- D Thermocouple

(5 × 1)

[5]

QUESTION 6

Choose an item from COLUMN B that matches a description in COLUMN A. Write only the letter (A–H) next to the question number (6.1–6.5) in the ANSWER BOOK.

COLUMN A		COLUMN B	
6.1	Error in a program <input checked="" type="checkbox"/>	A	RAM
6.2	Obsolete microprocessor	B	flow chart
6.3	Graphical representation of a program	C	assembler
6.4	Volatile memory	D	ROM
6.5	Currently used microprocessor	E	Pentium
		F	8086 <input checked="" type="checkbox"/>
		G	bug
		H	BASIC


(5 × 1)

[5]
[30]**TOTAL SECTION A: 30****SECTION B****QUESTION 7**


Computers are commonly used in industry to control analogue devices. Read the following scenario very carefully and answer the questions that follow:

A nuclear reactor is to have its temperature controlled by a computer. The control room in which the computer is housed is remotely situated. The computer must control two valves that must control the flow of water to keep the reactor within its operating temperatures of 1 200 °C and 1 300 °C.



- 7.1 What type of transducer could be used to measure the temperatures that are required as triggers for the computer? (1)
- 7.2 Would the loop from the computer to the reactor be described as the feedback loop or as the action loop? (1)

- 7.3 Draw a fully labelled block diagram to describe the digital process control system that would be used to accomplish the above task. All elements in the system must be included and clearly labelled. All signal directions must be shown as well.  (12)
- 7.4 A multiplexer (mux) is a versatile piece of hardware.
Aside from multiplexing, name FOUR other applications it can serve in a digital system. (4)
[18]

QUESTION 8

- 8.1 If a computer is connected to a server via the telephone lines, certain hardware is implicitly needed to interface this connection.
Draw a block diagram to illustrate the interfacing elements required on the side of the subscriber's computer and on the internet service provider's side. Also clearly indicate the mode of signal after each element. (6)
- 8.2 Draw a block diagram of a modem.  (4)
- 8.3 What does the acronym *modem* stand for? (1)
[11]

QUESTION 9

- 9.1 Control units vary from one computer to another.
Base your answer on the Von Neumann architecture, where a common RAM holds all data and program instructions, necessitating a fetch and an execute routine. 
Draw a fully labelled block diagram of a control unit that is integrated with a RAM and driven by a six-bit ring counter. All the gates and interconnections between the registers must be included. (10)
- 9.2 What digital component is used as the 6 bit ring counter in QUESTION 9.1? (1)
- 9.3 If, at the beginning of a machine cycle in the control unit that was drawn in QUESTION 9.1, the programme counter had the value 1001_2 in it, what would its contents be at the end of the cycle?  (1)
- 9.4 If the command to load the accumulator in the control unit of QUESTION 9.1 was given, the last pulse or phase would be a 'do-nothing' phase.
Why would this be? (3)
[15]

QUESTION 10

10.1 Consider the following FORTRAN program segment:

```

DIRE = 8
STRAITS = 8
355 MARK = DIRE + STRAITS
STRAITS = STRAITS + 7
IF (MARK.LT.35) THEN 355
PRINT, DIRE
PRINT, STRAITS
PRINT, MARK
STOP
END

```



Draw a table with the following headings: PASS, DIRE, STRAITS, MARK. Now clearly show how each value changes with each successive pass. Finally, beneath the table, show clearly what the final printout would look like.

(10)

10.2 Give an example where batch processing would be necessary.



(1)

10.3 Give an example where real-time processing would be necessary.

(1)

[12]**QUESTION 11**

11.1 The following word is received in Hamming code:

**1000011110**_{hamming}

By showing all the steps involved, find the fault in the word. Clearly state the bit number on which the fault lies and then rewrite the correct word, clearly indicating which bit has been corrected.

(10)

11.2 Write the following floating-point number in decimal, showing all your steps.

0 110 0 00011101

(3)

11.3 Demonstrate any variation of the Boolean commutative law using the variables D and E.

(1)

[14]

TOTAL SECTION B: 70
GRAND TOTAL: 100