higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

DIGITAL ELECTRONICS N6

(8080376)

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This question paper consists of 8 pages.

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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. Start each section on a new page.
5. Diagrams should be large, neat and clear and may be done in pencil.
6. Use only a black or blue pen.
7. Write neatly and legibly.

SECTION A

QUESTION 1

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 (1.1.1–1.1.5) in the ANSWER BOOK.

1.1.1 A device that accepts several data inputs and allows only one of them at a time to appear at the output:

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

1.1.2 The following transducer relies on the Seebeck effect:

A Thermostat
B Thermometer
C Thermocouple
D Thermistor

1.1.3 … is the smallest change in input that can cause a change in output.

A Quantising error
B Settling time
C Conversion time
D Resolution

1.1.4 The … code helps to prevent glitches (incorrect voltages) in counters.

A Hamming decimal
B Gray
C Boolean
D Binary

1.1.5 The Boolean expression A + ABC can be simplified to …

A ABC
B A
C A + BC
D BC + A

(5 × 1) (5)

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

Computer languages that use instructions that look like English words are referred to as (1.2.1) … An example of this would be (1.2.2) … The computer itself should convert these languages into (1.2.3) … that consists of ones and zeroes. The computer can do this by either (1.2.4) … the programme, which makes the programme fast bust difficult to debug, or it can do this by (1.2.5) …, which slows the programme down but allows for easier debugging.

(5 × 1) (5)

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

COLUMN A		COLUMN B	
1.3.1	The process of synchronising modems	A	solar flare
1.3.2	A source of transmission noise	B	binary
1.3.3	Integrated circuit used for detecting even parity	C	XOR gate
1.3.4	Integrated circuit used for detecting odd parity	D	handshaking
1.3.5	An error detection code	E	Hamming
		F	AND gate
		G	XNOR gate

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

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

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

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

1.4.5 Boolean algebra is used to simplify gated circuits.

(5 × 1) (5)

1.5 Choose an option from the list below for each of the following descriptions by writing only the answer next to the question number (1.5.1–1.5.5) in the ANSWER BOOK.

RAM; flow chart; bug; real-time computing; 8086

1.5.1 An error in a program

1.5.2 An obsolete microprocessor

1.5.3 Graphical representation of a program

1.5.4 A volatile memory

1.5.5 A system whereby commands are executed as and when the data is entered

(5 × 1) (5)

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

1.6.1 Frequency shift keying is generated by a (modem/UART).

1.6.2 The interface that converts parallel data into serial data and vice versa is a (modem/UART).

1.6.3 (Google/Windows) is a widely used operating system.

1.6.4 If a 10-bit DAC has a step size of 1 mV, its full-scale voltage would be (1,023 V/0,511 V).

1.6.5 A.(B.C) = (A.B).C is known as the (associative/distributive) rule in Boolean algebra.

(5 × 1) (5)
[30]

TOTAL SECTION A: 30

SECTION B

QUESTION 2: COMPUTER SYSTEMS

Read the following scenario carefully and answer the questions.

Computers are commonly used in industry to control analogue devices.

A computer should control the temperature of a chicken run on a commercial farm. The computer must control eight fans that switch on when the temperature goes above 24 °C. When the temperature drops below 19 °C the fans must be switched off. The temperature is monitored by six strategically placed thermistors and the computer is placed at the main farmhouse, which is located very far from the chicken run.

Draw a neat, fully labelled block diagram to show 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. Clearly indicate which loop is the control loop and which loop is the action loop. **[12]**

QUESTION 3: TRANSMISSION, DATA AND RELATED SOFTWARE

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

Name THREE applications of a digital system, other than multiplexing. (3)

3.2 The primary function of a demultiplexer (demux) is to return multiplexed signals to their original format.

Give another function of a demultiplexer. (1)

3.3 A PCM system should transmit the following packages using RZ (return to zero):

1111 0000 0011 1001

Graphically show how the transmission would look, using all four bits in the string. (4)

3.4 Briefly state the function of the modem on the transmit side and on the receive side of a digital device. (2)

3.5 Draw a simple labelled diagram to show how frequency shift keying (fsk) works. (3)

[13]

QUESTION 4: COMPUTER ARCHITECTURE

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.

4.1 Draw a neat, fully labelled block diagram of a control unit that has 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 each other. (10)

4.2 Use the following table to show what happens after each pulse from the microinstruction unit in QUESTION 4.1. Clearly separate each micro-instruction from the next and clearly show how the microinstructions are grouped into routines.

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

INSTRUCTION LOCATION	INSTRUCTION WORD	DESCRIPTION
1010	1111 0010	The contents of address 0010 is 1110 1110. This must be loaded into the accumulator.

(10)
[20]

QUESTION 5: HIGH-LEVEL PROGRAMMING

5.1 Consider the following FORTRAN program segment:

```
      MONTY = 8
      PYTHON = 12
355 ANSWER = MONTY + PYTHON
      MONTY = MONTY + 8
      IF (ANSWER.LT.35) THEN 355
      PRINT, ANSWER
      PRINT, MONTY
      PRINT, PYTHON
      STOP
      END
```

Draw a table with the following headings: PASS, MONTY, PYTHON, ANSWER. Clearly show how each value changes with each successive pass. Clearly show beneath the table what the final printout would look like. (7)

5.2 Before any program is written by a programmer, a systems analyst must first make a feasibility study to ascertain if a system is worth automating or not.

State FIVE criteria that a system analyst must address when compiling a feasibility study. (5)
[12]

QUESTION 6: NUMBER SYSTEMS

6.1 The following word was received in Hamming code:

$1010111011_{hamming}$

Find the fault in the word and show all the steps involved. Clearly state the bit number on which the fault lies and then rewrite the correct word clearly indicating which bit has been corrected. (10)

6.2 Write the following floating-point number in decimal, showing all the steps:

0 100 0 00110000 (3)
[13]

TOTAL SECTION B: 70
GRAND TOTAL: 100