



higher education & training

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NATIONAL CERTIFICATE

DIGITAL ELECTRONICS N6

(8080376)

2 April 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.
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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 A device that accepts several data inputs and allows only one at a time to appear at the output:

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

1.1.2 The following transducer relies on the Seebeck effect:

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

1.1.3 The difference between analogue input and digital output:

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

1.1.4 The number of functions a digital device can perform:

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

(4 × 1) (4)

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

1.2.1 A thermistor can be either NTC or PTC.

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

1.2.3 A decoder in the control unit of a computer decodes the address.

1.2.4 The bus on a computer is used to transport addresses, data and control signals between the CPU and peripheral devices.

(4 × 1) (4)

- 1.3 Choose a term from COLUMN B that matches a 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	IC manufacturer	A	USB
1.3.2	Microprocessor	B	MUX
1.3.3	Port connected directly onto the bus	C	Intel
1.3.4	Volatile memory	D	RAM
		E	ROM
		F	Pentium

(4 × 1)

(4)

- 1.4 Draw a fully labelled diagram of a computer numeric control (CNC) system that would be used in a profile-cutting production system and briefly describe the operation of the system.

(8)

[20]

QUESTION 2: TRANSMISSION, DATA ACQUISITION 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 Which ONE of the following pieces of equipment is essential when connecting a computer to the internet across telephone wires:

- 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 internet browser:

- A Windows
- B Linux
- C Apple
- D Google Chrome

2.1.4 Communication system that requires no start and stop bits:

- A Frequency-shifted keying
- B Wireless transmission
- C Synchronous transmission
- D Asynchronous transmission

(4 x 1) (4)

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

2.2.1 Modem tones can be heard by the human ear.

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

2.2.3 PCM stands for parity-coded modulation.

2.2.4 Hamming code is commonly used as an error-detecting code.

(4 x 1) (4)

2.3 Choose a term from COLUMN B that matches a 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	Used for even parity	A	Hamming code
2.3.2	Used for odd parity	B	Gray code
2.3.3	Source of transmission noise	C	handshaking
2.3.4	Process of synchronising modems	D	solar flare
		E	XNOR gate
		F	XOR gate

(4 x 1) (4)

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

Name FOUR applications of a multiplexer, other than multiplexing, in a digital system.

(4)

2.5 A PCM system must transmit the following packages using NRZ (nonreturn to zero):

1000 1110 1100 0110

Use ALL FOUR bits in the string and show the transmission graphically.

(4)
[20]

QUESTION 3: COMPUTER ARCHITECTURE

Control units vary from one computer to another. Base your answers to the following questions on the Von Neumann Architecture where a common RAM holds all data and program instructions, necessitating a fetch-and-execute routine.

3.1 Draw a fully labelled block diagram of a control unit integrated with a random access memory (RAM) and driven by a six-bit ring counter. Include ALL gates and interconnections between the registers.

(10)

3.2 Use the table below to show what happens after each pulse from the micro-instruction unit in QUESTION 3.1. Clearly separate each micro-instruction from the next and clearly show how the micro-instructions 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
0011	1100 0001	The content of address 0001 is 1111 1111. This must be loaded into the accumulator.

(10)
[20]

QUESTION 4: HIGH-LEVEL PROGRAMMING

- 4.1 Consider the following BASIC program. Follow the instructions in the remark statements and do exactly what it says. The answer in the ANSWER BOOK must be exactly what the on-screen printout would be.

```
10 REM The following program is used to place a notice on the screen
20 REM of the user. Carefully analyse the conditional GOTO
30 REM statements in this program and then write the text that would
40 REM be printed on the screen in your answer book exactly as it
50 REM would be printed on-screen.
60 LET WORDS01$ = 'PAY ATTENTION'
70 LET WORDS02$ = 'TO WHAT HAS'
80 LET WORDS03$ = 'TO BE DONE!'
90 LET WORDS04$ = 'CONCENTRATE'
100 LET WORDS05$ = 'ON THE TASK'
110 LET WORDS06$ = 'AT HAND'
120 LET WORDS07$ = 'NEVER WAIVER'
130 LET WORDS08$ = 'IN YOUR QUEST'
140 LET WORDS09$ = 'FOR EXCELLENCE'
150 LET WORDS10$ = 'YOU ARE A CHILD OF'
160 LET WORDS11$ = 'THE UNIVERSE'
170 LET WORDS12$ = 'NO LESS THAN THE TREES'
180 LET WORDS13$ = 'AND THE STARS'
190 LET WORDS14$ = 'YOU HAVE A RIGHT TO BE HERE'
200 LET WORDS15$ = 'NOTHING'
210 LET WORDS16$ = 'BEGETS'
220 LET WORDS17$ = 'NEVER UNDERESTIMATE'
230 LET WORDS18$ = 'A CHILD'
240 LET WORDS19$ = 'NEVER OVERESTIMATE'
250 LET WORDS20$ = 'AUTHORITY'
260 LET WORDS21$ = 'YOUR CAREER, HOWEVER HUMBLE'
270 LET WORDS22$ = 'IS A REAL POSSESSION'
280 LET WORDS23$ = 'IN THE CHANGING FORTUNES OF TIME'
290 LET WORDS24$ = ''
300 LET WORDS25$ = 'BE GOOD TO THOSE'
310 LET WORDS26$ = 'YOU MEET ON THE WAY UP'
320 LET WORDS27$ = 'YOU NEVER KNOW WHO'
330 LET WORDS28$ = 'YOU WILL MEET ON YOUR'
340 LET WORDS29$ = 'WAY DOWN'
350 LET WORDS30$ = 'A SMILE CAN'
360 LET WORDS31$ = 'WORK WONDERS'
370 LET WORDS32$ = 'YOU CAN NEVER BE TOO'
380 LET WORDS33$ = 'BUSY TO RETURN A'
390 LET WORDS34$ = 'SMILE'
400 LET WORDS35$ = 'BE CHEERFUL'
410 LET WORDS36$ = 'STRIVE TO BE HAPPY'
420 REM Carefully note what is entered into the next variables as
430 REM they will govern which text will be printed.
440 LET TODAYSPRINT01$ = 'WEEK1'
450 LET TODAYSPRINT01$ = 'WEEK2'
```

```
460 LET TODAYSPRINT01$ = 'WEEK3'  
470 LET TODAYSPRINT02$ = 'WEEK1'  
480 LET TODAYSPRINT02$ = 'WEEK2'  
490 LET TODAYSPRINT03$ = 'WEEK1'  
500 REM Now you can work out what is to be printed today by following the  
510 REM conditional GOTO statements.  
520 PRINT 'THE WORDS OF WISDOM FOR TODAY ARE'  
530 PRINT  
540 PRINT  
550 IF TODAYSPRINT01$ = 'WEEK1' THEN GOTO 610  
560 IF TODAYSPRINT01$ = 'WEEK2' THEN GOTO 630  
570 IF TODAYSPRINT01$ = 'WEEK4' THEN GOTO 650  
580 IF TODAYSPRINT02$ = 'WEEK1' THEN GOTO 690  
590 IF TODAYSPRINT02$ = 'WEEK2' THEN GOTO 750  
600 IF TODAYSPRINT03$ = 'WEEK3' THEN GOTO 770  
610 PRINT WORDS01$, WORDS24$, WORDS02$, WORDS24$,  
WORDS03$  
620 GOTO 800  
630 PRINT WORDS04$, WORDS24$, WORDS05$, WORDS24$,  
WORDS06$  
640 GOTO 800  
650 PRINT WORDS07$, WORDS24$, WORDS08$, WORDS24$,  
WORDS09$  
660 GOTO 800  
670 PRINT WORDS10$, WORDS24$, WORDS11,$ WORDS24$,  
WORDS12$, WORDS24$, WORDS13$, WORDS24$, WORDS14$  
680 GOTO 800  
690 PRINT WORDS15$, WORDS24$, WORDS16$, WORDS24$,  
WORDS15$  
700 GOTO 800  
710 PRINT WORDS17$, WORDS24$, WORDS18$, WORDS24$,  
WORDS19$, WORDS24$, WORDS20$  
710 GOTO 800  
720 PRINT WORDS21$, WORDS24$, WORDS22$, WORDS24$,  
WORDS23$  
725 GOTO 800  
730 PRINT WORDS25$, WORDS24$, WORDS276$ WORDS24$,  
WORDS27$, WORDS24$, WORDS28$, WORDS24$, WORDS29$  
740 GOTO 800  
750 PRINT WORDS30$, WORDS24$, WORDS31$  
760 GOTO 800  
770 PRINT WORDS32$, WORDS24$, WORDS33$, WORDS24$,  
WORDS34$  
780 GOTO 800  
790 PRINT WORDS35$, WORDS24$, WORDS36$  
800 END
```

(10)

4.2 The program in QUESTION 4.1 was written in BASIC.

What does the acronym BASIC stand for?

(2)

- 4.3 Before a programmer writes any program, a systems analyst must first conduct a feasibility study to ascertain if a system is worth automating or not.
List SIX criteria a system analyst must address when conducting a feasibility study. (6)
- 4.4 When a program is executed it can either be real-time or batch processed.
Give ONE real example of each. (2)
- [20]**

QUESTION 5: NUMBER SYSTEMS

- 5.1 The following word is received in Hamming code:
1000011110_{hamming}
Find the fault in the word. Show ALL steps. Clearly state the bit number on which the fault lies and rewrite the correct word clearly indicating which bit has been corrected. (10)
- 5.2 Write the following floating-point number in decimal showing ALL steps:
0 110 0 00011001 (3)
- 5.3 Solve the following using Boolean algebra:
 $F = A.B.B.C + C.A. \bar{A}.B + \bar{A}$ (3)
- 5.4 Rewrite the following binary number in the binary code:
1001011_{gray} (2)
- 5.5 State why the XS-3 and 2.4.2.1. codes were developed. (2)
- [20]**

TOTAL: 100