



higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

DIGITAL ELECTRONICS N6

(8080376)

**3 April 2020 (X-paper)
09:00–12:00**

This question paper consists of 9 pages.

082Q1A2003

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 question on a new page.
 5. Write neatly and legibly.
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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 takes a single input and distributes it over several outputs:

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

1.1.2 A transducer that experiences a decrease in resistance when the temperature increases:

- A Thermometer
- B Thermocouple
- C NTC-thermistor
- D PTC-thermistor

1.1.3 The difference between analogue input and digital output:

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

1.1.4 The number of functions a digital device can perform:

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

1.1.5 The Boolean expression $\bar{A} + ABC$ simplified:

- A $\bar{A}BC$
- B \bar{A}
- C $\bar{A} + BC$
- 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.

8421 is an example of a code that is (1.2.1) ... and (1.2.2) ... XS-3 is an example of a code that is (1.2.3) ... and (1.2.4) ... (1.2.5) ... is an example of a code that is complimentary and weighted. (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	Error in a program	A bug
1.3.2	Obsolete microprocessor	B flow chart
1.3.3	Graphical representation of a program	C RAM
1.3.4	Volatile memory	D motherboard
1.3.5	Contains central processing unit	E Pentium
		F ROM
		G 8085

(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 Modem tones are audible by the human ear.

1.4.2 PCM stands for parity-coded modulation.



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

1.4.4 A virus can enhance the performance of a computer.


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

(5 × 1)

(5)



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

solar flare; XOR gate; handshaking; Gray code; NAND gate
--

- 1.5.1 Finds a low-level input (0 V) from two or more inputs and responds by giving a high output (+5 V) 
- 1.5.2 Periodic fiery explosions on the surface of the sun that can severely affect electrical communications on earth
- 1.5.3 Process whereby two modems synchronise with each other when they meet
- 1.5.4 Generates even parity
- 1.5.5 System used in serial up/down counters

(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 The interrupt generated by an event outside of the computer is an (internal/external) interrupt. 
- 1.6.2 A dongle-type modem is inserted in a (USB/RS-232) port.
- 1.6.3 A (synchronous/asynchronous) system requires no start and stop bits.
- 1.6.4 If a 9-bit ADC has a threshold voltage of 1 mV, its full-scale voltage would be (1,023 V/0,511 V). 
- 1.6.5 If the outputs of three transducers have been digitised and must be sent to a remote computer, the outputs of the transducers must be connected to a (MUX/modem) before transmission.



(5 × 1) (5)
[30]

TOTAL SECTION A: 30


SECTION B**QUESTION 2: COMPUTER SYSTEMS**

Read the scenario below and answer the questions.

The temperature of a nuclear reactor must be 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 1 400 °C and 1 800 °C.

- 2.1 2.1.1 Draw a neat, fully labelled block diagram to explain the digital process-control system that would be used to accomplish the given task. Include and clearly label all elements in the system. Show all signal directions as well. Clearly indicate which loop is the control loop and which loop is the action loop. (12)
- 
- 2.1.2 Name the type of transducer used to measure the temperatures of the reactor. (1)
- 
- 2.1.3 On which principle does the transducer in QUESTION 2.1.2 work? (1)
- [14]**


QUESTION 3: TRANSMISSION, DATA AND RELATED SOFTWARE

- 3.1 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 when a computer is connected to a server via telephone lines. Clearly indicate the mode of signal after each element. (6)
- 
- 3.2 Draw the block diagram of a modem. (4)
- [10]**

QUESTION 4: COMPUTER ARCHITECTURE

Read the scenario below and answer the questions.

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

- 4.1 Draw a fully labelled block diagram of a control unit integrated with random access memory (RAM) and driven by a six-bit ring-counter. Include all gates and interconnections between the registers. (10)
- 

- 4.2 Use the following table to show what happens after each pulse from the micro-instruction unit QUESTION 4.1. 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 clearly show what happens when the control unit receives the instruction to add a number to the accumulator.



INSTRUCTION LOCATION	INSTRUCTION WORD	DESCRIPTION
1001	0111 1101	The contents of address 1101 is 1011 1011. This must be added to the contents of the accumulator.

(10)
[20]

QUESTION 5: HIGH-LEVEL PROGRAMMING

- 5.1 Consider the following BASIC program. Follow the instruction in the remark statement 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 of
20 REM the user. Carefully analyse the conditional GOTO statements in
30 REM the program and then write the text that would be printed on the
40 REM screen in the ANSWER BOOK exactly as it would be printed
50 REM 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"

```



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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 Take careful note of what is entered into the next variables as it
430 REM will govern which text will be printed.
440 LET TODAYSPRINT01$ = "WEEK1"
450 LET TODAYSPRINT01$ = "WEEK2"
460 LET TODAYSPRINT01$ = "WEEK4"
470 LET TODAYSPRINT02$ = "WEEK3"
480 LET TODAYSPRINT02$ = "WEEK2"
490 LET TODAYSPRINT02$ = "WEEK1"
500 REM Now you can work out what is to 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$ = "WEEK3" THEN GOTO 650
580 IF TODAYSPRINT02$ = "WEEK1" THEN GOTO 690
590 IF TODAYSPRINT02$ = "WEEK2" THEN GOTO 750
600 IF TODAYSPRINT02$ = "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)

- 5.2 What do the acronyms *Fortran* and *Cobol* stand for? (2)
- 5.3 The following is a schematic drawing of a stack with its contents.

Stack pointer
03

Stack

Address	Contents
01	68 ₁₆
02	B8 ₁₆
03	8B ₁₆

Redraw the stack and the stack pointer to show what the contents would look like if the number 3B₁₆ is pushed onto the stack. (3)

- 5.4 Give ONE example where real-time processing is used in everyday life. (1)
- [16]**

QUESTION 6: NUMBER SYSTEMS

The following word is received in Hamming code:

0000111110_{hamming}

Show all steps involved to 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]

TOTAL SECTION B: 70
GRAND TOTAL: 100