higher education & training

Department:
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REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

DIGITAL ELECTRONICS N6

(8080376)

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Drawing instruments may be used.

This question paper consists of 10 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. Use only a blue or black pen.
6. Write neatly and legibly.

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SECTION A

QUESTION 1

Give ONE word/term for each of the following descriptions. Write only the word/term next to the question number (1.1–1.5) in the ANSWER BOOK.

1.1 An interrupt generated by the computer itself.

1.2 The system that modems use to convert high-frequency signals into audio signals.

1.3 The state of a computer when all data is exclusively fed in locally by the person operating the computer.

1.4 A transducer used to measure extremely high temperatures (t > 1 000 °C).

1.5 An example of a control system that sequences a machine tool through various operations.

(5 × 1) **[5]**

QUESTION 2

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 (2.1–2.5) in the ANSWER BOOK.

2.1 Which ONE of the following is an error-detecting code?

A Grey code
B Binary coded decimal
C Hamming code
D XS-3 code

2.2 What is represented in symbolic form below?

A.(B + C) = A.B + A.C

A The distributive rule.
B The absorption theorem.
C The associative rule.
D De Morgan's theorem.

2.3 Which ONE of the following is the solution for: A.B.0 + 1?

A A
B B
C 0
D 1

2.4 The binary equivalent of the Grey code 11100_{grey} is …

A 10010_2.
B 10101_2.
C 10110_2.
D 10111_2.

2.5 The binary equivalent of 0001 $1000_{8.4.2.1}$ is …

A 10010_2.
B 11000_2.
C 00011_2.
D 11111_2.

(5 × 1) **[5]**

QUESTION 3

Choose a/an word/item from COLUMN B that matches a description in COLUMN A. Write only the letter (A–H) next to the question number (3.1–3.5) in the ANSWER BOOK.

COLUMN A		COLUMN B	
3.1	Changes digital inputs into analogue outputs	A	pulse distributor
3.2	The smallest change that can occur in the output as a result of a change in input	B	resolution
3.3	The difference between the digital input and analogue output	C	quantising error
3.4	A multiplexer application	D	settling time
3.5	A demultiplexer application	E	data routing
		F	full-scale voltage
		G	DAC
		H	ADC

(5 × 1) **[5]**

QUESTION 4

Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'True' or 'False' next to the question number (4.1–4.5) in the ANSWER BOOK.

4.1 A feasibility study is highly technical in nature.

4.2 PLCs are an example of microcomputers used in industrial applications.

4.3 COBOL is used primarily as a scientific language.

4.4 A Pentium chip is part of a RAM.

4.5 A tri-state switch is associated with access to a computer's busses.

(5 × 1) **[5]**

[20]

TOTAL SECTION A: 20

SECTION B

QUESTION 5: COMPUTER SYSTEMS

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

A chicken run on a commercial farm is to have its temperature controlled by a computer. The computer must control ten fans that switch on when the temperature goes above 24 °C. If the temperature drops below 20 °C, the fans must be switched off. The temperature is monitored by four strategically placed thermistors.

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 labelled, including the devices to input and monitor temperature changes. All signal directions must be shown as well. **[10]**

QUESTION 6: TRANSMISSION, DATA AND ASSOCIATED HARDWARE

6.1 Draw the block diagram of a modem and very briefly state the function of the modem on the transmit side as well as on the receive side. (6)

6.2 The following data packages are transmitted by means of PCM (pulse-code modulation), which uses RZ (return to zero).

0000 1111 1000 0110

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

6.3 Name TWO applications of batch processing. (2)

6.4 Name THREE sources of noise in analogue transmissions that are eliminated by means of digital transmissions. (3)

6.5 Name any TWO search engines commonly used on computers and other communication devices. (2)

6.6 An 8-bit DAC produces an output voltage of 100 µV for an input of 00000001_2.

6.6.1 Calculate the full-scale voltage of the DAC. (2)

6.6.2 Calculate the output voltage when 00011110_2 appears at the input. (1)

[20]

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QUESTION 7: COMPUTER ARCHITECTURE

7.1 Control units vary from one computer to another. Base your answer on the Von Neumann Architecture according to which a common RAM holds all data and program instructions, necessitating a fetch and an execute routine.

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

7.2 Use the following table to show what happens after each pulse from the micro-instruction unit in QUESTION 7.1 above. Separate each micro-instruction from the next and show how they are grouped into routines.

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

INSTRUCTION LOCATION	INSTRUCTION WORD Op-code	Address	DESCRIPTION
0011	1110	0110	The contents of address 0110 is 1000 1000. This must be loaded into the accumulator

(10)
[20]

QUESTION 8: HIGH-LEVEL PROGRAMMING

8.1 Consider the following BASIC program. Follow the instruction in the remark statement and do EXACTLY what it says. The answer in your 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$ = "READ THE INSTRUCTIONS"
70  LET WORDS02$ = "BEFORE ATTEMPTING"
80  LET WORDS03$ = "THE ASSMEBLY OF ANYTHING"
90  LET WORDS04$ = "EVERYTHING UNDER"
100 LET WORDS05$ = "THE SUN IS IN TUNE"
110 LET WORDS06$ = "BUT THE SUN"
120 LET WORDS07$ = "IS ECLIPSED"
130 LET WORDS08$ = "BY THE MOON"
140 LET WORDS09$ = "EXERCISE CAUTION"
150 LET WORDS10$ = "IN YOUR BUSINESS AFFAIRS"
160 LET WORDS11$ = "FOR THE WORLD IS FULL OF TRICKERY"
```

```
170   LET WORDS12$ = “LEGALISE”
180   LET WORDS13$ = “WHAT SHOULD NOT BE”
190   LET WORDS14$ = “CRIMINALISED”
200   LET WORDS15$ = “ALL THE WORLD”
210   LET WORDS16$ = “IS A STAGE”
220   LET WORDS17$ = “ ”
230   LET WORDS18$ = “AN EVIL PERSON”
240   LET WORDS19$ = “TELLS YOU WHAT”
250   LET WORDS20$ = “YOU WANT TO HEAR”
260   LET WORDS21$ = “A GOOD PERSON”
270   LET WORDS22$ = “TELLS YOU WHAT”
280   LET WORDS23$ = “YOU HAVE TO HEAR”
290   LET WORDS24$ = “NONE ARE SO BLIND“
300   LET WORDS25$ = “AS THOSE”
310   LET WORDS26$ = “WHO DO NOT WANT TO SEE”
320   LET WORDS27$ = “A MAN WHO IS NOT GENTLE”
330   LET WORDS28$ = “WILL NEVER UNDERSTAND”
340   LET WORDS29$ = “A WOMAN”
350   LET WORDS30$ = “THOSE WHO WANT TO LEAD”
360   LET WORDS31$ = “ARE SNAKES”
370   LET WORDS32$ = “THAT CAN SMILE”
380   LET WORDS33$ = “PAY NO ATTENTION TO THOSE”
390   LET WORDS34$ = “WHO SING WITH THEIR TONGUES ON FIRE”
400   LET WORDS35$ = “BE CHEERFUL”
410   LET WORDS36$ = “STRIVE TO BE HAPPY”
420   REM Take note of 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$ = “WEEK2”
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$ = “WEEK3” THEN GOTO 650
580   IF TODAYSPRINT02$ = “WEEK1” THEN GOTO 670
590   IF TODAYSPRINT02$ = “WEEK2” THEN GOTO 690
600   IF TODAYSPRINT03$ = “WEEK3” THEN GOTO 820
610 PRINT WORDS01$, WORDS17$, WORDS02$, WORDS17$, WORDS03$
620   GOTO 820
630   PRINT WORDS12$, WORDS17$, WORDS13$, WORDS17$,
WORDS14$
640   GOTO 820
```

```
650   PRINT WORDS04$, WORDS17$, WORDS05$,
660   GOTO 710
670   PRINT WORDS15$, WORDS17$, WORDS16,$
680   GOTO 820
690 PRINT WORDS18$, WORDS17$, WORDS19$, WORDS17$, WORDS20$
700   GOTO 750
710 PRINT WORDS06$, WORDS17$, WORDS07$, WORDS17$, WORDS08$
720   GOTO 820
730 PRINT WORDS09$, WORDS17$, WORDS10$, WORDS17$, WORDS11$
740   GOTO 820
750 PRINT WORDS21$, WORDS17$, WORDS22$ WORDS17$, WORDS23$,
760   GOTO 820
770   PRINT WORDS33$, WORDS17$, WORDS34$
780   GOTO 820
790 PRINT WORDS27$, WORDS17$, WORDS28$, WORDS17$, WORDS29$
800   GOTO 820
810   PRINT WORDS35$, WORDS17$, WORDS36$
820   END
```

(10)

8.2 The following is a section of a program in machine code.

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

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

ADDRESS	ADDRESS CONTENTS
1001	55_{16}
1010	44_{16}
1011	11_{16}
1100	66_{16}
1101	22_{16}

Rewrite each instruction number one below the other. Next to it, show the accumulator contents after each instruction has been completed. (5)

[15]

QUESTION 9: NUMBER SYSTEMS

9.1 The following word is received in Hamming Code. Showing ALL the steps involved and find the fault in the word. State the bit number on which the fault lies and then rewrite the correct word by indicating which bit has been corrected.

$1011111110_{hamming}$ (7)

9.2 Write the following floating point numbers in decimal, showing all your steps.

9.2.1 **0 010 0 1111000** (3)

9.2.2 **0 010 1 1111000** (3)

9.3 Simplify the following Boolean problem:

$\bar{A}\bar{G}\bar{E} + \bar{A}\bar{G}E + A\bar{G}\bar{E} + A\bar{G}E$ (2)

[15]

TOTAL SECTION B: 80
GRAND TOTAL: 100

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