higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T480**(E)**(J27)T

NATIONAL CERTIFICATE

DIGITAL ELECTRONICS N6

(8080376)

27 July 2018 (X-Paper)
09:00–12:00

Nonprogrammable calculators may be used.

This question paper consists of 7 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.

QUESTION 1: COMPUTER SYSTEMS

Computers are commonly used in industry to control analogue devices.

Carefully read the following scenario and answer the questions.

The temperature in a vat, used in the mashing process of beer-making in a brewery, has to be kept at a constant temperature of 72 ^{o}C. A remote computer controls the process of turning on a hot-water valve every time the vat cools down.

1.1 Draw a fully labelled block diagram to describe the digital process-control system that would be used to accomplish the above task.

Include and clearly label ALL the elements in the system including the device that would be used to monitor the temperature. All signal directions should be shown as well. (12)

1.2 Numeric control is another type of computer control.

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 Draw a block diagram of a complete 4-input acquisition system. The system must incorporate a random access memory, thus making it a more efficient system than if it had 3-state drivers. (8)

2.2 If a computer is connected to a server via 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)

2.3 Draw a 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)

[20]

QUESTION 3: 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.

3.1 Draw a fully labelled block diagram of a control unit integrated with a random access memory (RAM) and is driven by a six-bit ring counter. ALL the gates and interconnections between the registers must be included. (10)

3.2 Use the following table 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 add a number to the accumulator.

INSTRUCTION LOCATION	INSTRUCTION WORD	DESCRIPTION
1001	1111 0100	The contents of address 0100 is 1011 1011. This must be added to the contents of the accumulator.

(10)
[20]

QUESTION 4: HIGH-LEVEL PROGRAMMING

4.1 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 print-out 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 Take careful 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$ = 'WEEK6'
470 LET TODAYSPRINT02$ = 'WEEK1'
480 LET TODAYSPRINT02$ = 'WEEK2'
490 LET TODAYSPRINT03$ = 'WEEK3'
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 690
590 IF TODAYSPRINT02$ = 'WEEK2' THEN GOTO 790
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)

4.2 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 any SIX criteria that a system analyst should address when compiling a feasibility study. (6)

4.3 Give ONE everyday example where real-time processing would be necessary. (1)

4.4 The following is a schematic drawing of a stack with its contents. If the number $2F0_{16}$ is pushed onto the stack. Redraw the stack and the stack pointer to show what the contents would look like now.

Stack Pointer
05

Stack

Address	Contents
03	600_{16}
04	$3A2_{16}$
05	081_{16}

(3)
[20]

QUESTION 5: NUMBER SYSTEMS

5.1 The following word is received in Hamming code:

$0110011010_{hamming}$

Find the fault in the word by showing 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)

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

0 010 0 00110000 (3)

5.3 Rewrite the following binary coded decimal (8.4.2.1) in the 2.4.2.1 code:

$1000\ 1001\ 0000_{8.4.2.1}$ (3)

5.4 Rewrite the following Gray code number in binary:

1101011_{gray} (2)

5.5 Using the variables D, E and F, write down the general rule for the associative law in Boolean algebra. (2)
[20]

TOTAL: 100