higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T480(**E**)(A3)T

NATIONAL CERTIFICATE

DIGITAL ELECTRONICS N6

(8080376)

3 April 2018 (X-Paper)
09:00–12:00

Nonprogrammable calculators may be used.

This question paper consists of 5 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. Read the following scenario very carefully and answer the questions.

A high-temperature gas-cooled nuclear reactor is to have its temperature 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 gas to keep the reactor within its operating temperatures of 1 000 °C and 1 200 °C.

1.1 State what type of transducer could be used to measure the temperatures that are required as triggers for the computer. (1)

1.2 Would the loop from the computer to the reactor be described as the *feedback loop* or the *action loop*? (1)

1.3 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 clearly labelled. ALL signal directions must be shown as well. (12)

1.4 Before any computer system can be introduced, a systems analyst must first prepare a non-technical report so that management can make a decision whether or not to go ahead with the implementation of the system.

Name any SIX criteria the systems analyst should address in this report. (6)
[20]

QUESTION 2: TRANSMISSION, DATA ACQUISITION AND RELATED HARDWARE

2.1 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)

2.2 Show, by means of a simple diagram, how *frequency shifted keying* (fsk) works. (3)

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

Aside from multiplexing, name FOUR of its other applications in a digital system. (4)

2.4 If a computer is connected to a server via the 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 the signal after each element. (6)

2.5 State what the acronym UART stands for. (1)
[20]

QUESTION 3: COMPUTER ARCHITECTURE

Control units vary from one computer to another. Base your answer to this question 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 which is driven by a six-bit ring counter. ALL the gates and interconnections between the registers must be included. (10)

3.2 Use the table below to show what happens after each pulse from the micro-instruction unit in QUESTION 3.1 above. 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**
1010	0111 1110	The content of address 0111 is 1100 1100. This must be loaded into the accumulator.

(10)
[20]

QUESTION 4: HIGH-LEVEL PROGRAMMING

4.1 What do the acronyms BASIC and COBOL stand for? (2)

4.2 Consider the following FORTRAN program segment:

```
IMAGE = 15
TOOLBOX = 8
22002 ANSWER = IMAGE + TOOLBOX
TOOLBOX = TOOLBOX + 7
IF (ANSWER.LT.40) GO TO 22002
PRINT, ANSWER, IMAGE, TOOLBOX
STOP
END
```

Draw a table with the following headings: PASS, IMAGE, TOOLBOX, and ANSWER. Then show clearly how each value changes with each successive pass. Finally, below the table, show clearly what the final print-out will look like. (10)

4.3 Indicate the differences in *speed* and in *ease of de-bugging* between a compiled program and a translated program. Put your answer in tabular form. (4)

4.4 What is the difference between a *bug* in a program and a *virus* in a program? (2)

4.5 What is a *subroutine*? (2)
[20]

QUESTION 5: NUMBER SYSTEMS

5.1 The word below is received in Hamming code.

By showing ALL the steps involved find the fault in the word; clearly state the bit number on which the fault lies and then rewrite the word correctly, clearly indicating which bit has been corrected.

$1111111110_{hamming}$ (10)

5.2 Write the following floating-point number in decimal, showing ALL your steps:

0 100 0 11110000 (3)

5.3 Rewrite the following binary coded decimal (8.4.2.1) in the XS-3 code:

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

5.4 Rewrite the following Gray code number in binary:

1101001_{gray} (2)

5.5 Using the variables A, B and C, write down the general rule for the distributive law in Boolean algebra. (2)
[20]

TOTAL: 100