higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

LOGIC SYSTEMS N6

(8080306)

24 November 2023 (X-paper)
09:00–12:00

Drawing instruments may be used.

This question paper consists of 6 pages.

088Q1E2324

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DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
LOGIC SYSTEMS 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. Use only a blue or black pen.
5. Write neatly and legibly.

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QUESTION 1

Indicate whether the following statements are TRUE or FALSE by writing only 'True' or 'False' next to the question number (1.1–1.10) in the ANSWER BOOK. Give a reason for the answer.

1.1 When there is no JUMP instruction, the program counter is loaded with the address of the previous instruction which was jumped to.

1.2 The operand address of the current instruction is the only information stored by the instruction register.

1.3 The program counter stores a count of all the programs stored on the hard disk.

1.4 Magnetic tape is classified as sequential-access memory.

1.5 The Microsoft Office suite is well known as open-source software.

1.6 Direct memory access (DMA) does not need to take over control of the processor.

1.7 Computer operations are synchronised with the system clock oscillator.

1.8 Both machine code and assembler are classified as high-level languages.

1.9 During the READ cycle, data is read from the accumulator.

1.10 The accumulator stores ongoing results of computations.

(10 × 2) **[20]**

QUESTION 2

2.1 When an analogue voltage is measured, an A/D converter must be used. The voltage-to-frequency-to-digital converter uses a digital counter to present its output reading. Illustrate the operation of this type of converter with a neat block diagram. (6)

2.2 Briefly describe the operation of this voltage-to-frequency-to-digital converter. (6)

2.3 When the value of a series of digital pulses must be converted to an equivalent analogue voltage value, a serial D/A converter must be used.

Sketch a serial D/A converter.

Also draw the input and output waveforms for the series D/A converter and briefly describe the operation of this converter. (13)

[25]

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QUESTION 3

Operational amplifiers are widely used in non-linear circuit applications.

3.1 Draw a circuit diagram of an operational amplifier connected as a logarithmic amplifier. (4)

3.2 Draw a circuit diagram of an operational amplifier connected as a differentiator. (4)

3.3 Draw a circuit diagram of an operational amplifier connected to provide impedance matching from a high input impedance to a low output impedance providing a gain of 1. (3)

3.4 Draw a circuit diagram of an operational amplifier connected as a voltage comparator between a fixed reference voltage and an applied input voltage. (5)

3.5 Draw a circuit diagram of an operational amplifier connected as a Schmitt trigger. (4)

[20]

QUESTION 4

4.1 The following instruction set is available:

OP CODE	DESCRIPTION
LOAD	Load accumulator
ADDA	Add to accumulator
SUBT	Subtract from accumulator
MULT	Multiply
BRAN	Branch if the accumulator is negative
BRAP	Branch if the accumulator is positive
STOR	Store
OUTP	Output the contents of the accumulator
HALT	Halt (non-memory referenced instruction)

Note the following specifications and information when writing the program:

- All mathematical operations done before coding must be shown.
- The first program address with which the program counter is loaded is AACA (HEXADECIMAL).
- Case sensitivity: Operands must be in lower case.
- Case sensitivity: Addresses must be in upper case.
- You may NOT enlarge the instruction set.
- The program must stop processing if after any mathematical operation the contents of the accumulator is negative. (NOTE: *Negative*).

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- The correct delimiter must be used after delivering the output so that memory use is limited to program lines.

The operands r, s, t, u v, w, x, y and z are stored in consecutive hexadecimal addresses:

Operand r is stored in address F1C1.
Operand s is stored in address F1C2.
Operand t is stored in address F1C3.
Operand u is stored in address F1C4, and so on in sequence.

The correct programming fields appear in the table below:

INSTRUCTION LOCATION	INSTRUCTION WORD		DESCRIPTION
	OP CODE	ADDRESS	

Use the correct programming fields to write a program to calculate the value of x if:

x = uyz + tuy (10)

4.2 Microprocessors make use of either Harvard or Von Neumann architecture. Draw a block diagram to illustrate the construction of a Von Neumann architecture microprocessor. (5)

4.3 Briefly explain the major difference in operation between a *Harvard architecture microprocessor* and that of a *Von Neumann architecture microprocessor*. (5)

[20]

QUESTION 5

5.1 Explain the term *machine cycle* of a digital computer by illustrating with a drawing how this can be presented on a timing diagram. (6)

5.2 FIGURE 1 below shows the block diagram of a very simple computer or microprocessor system. Name the FIVE major parts as well as the THREE internal busses. The blocks are numbered from 5.2.1 to 5.2.9.

Write down the correct number for each block in sequence and then provide the correct label for each block.

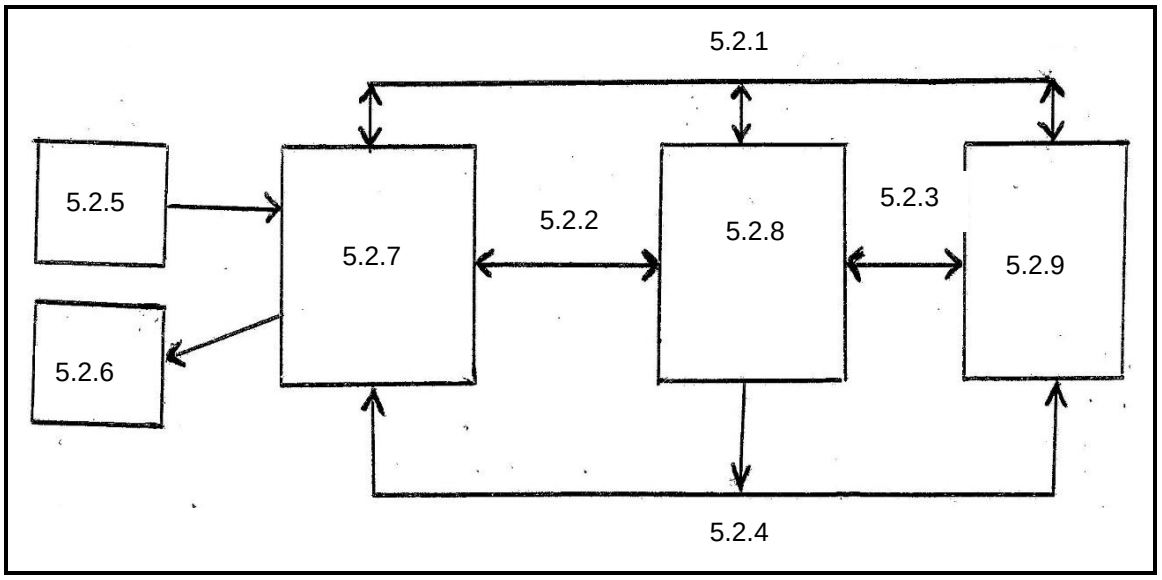

FIGURE 1

(9)
[15]

TOTAL: 100

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