higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

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NATIONAL CERTIFICATE

LOGIC SYSTEMS N6

(8080306)

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09:00–12:00

Calculators may be used.

This question paper consists of 6 pages.

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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. Write neatly and legibly.

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NOTICE TO CANDIDATES

The lives and safety of people depend on logic systems. Logic systems form an integral part of intrinsic safety in equipment. Logic signalling systems prevent trains from colliding. Logic systems keep people safe in aircraft and in hospital intensive-care units. Your work, programming and designs, must be properly planned and presented at this diploma-level examination. Standards must be maintained for the safety of the public and safe operation of machinery.

QUESTION 1

1.1 Draw a large, neat, fully labelled block diagram to show how a programmable logic controller (PLC) is used to control two electric motors driving two conveyer belts. The two electric motors run two vibrators under a conveyer belt. The PLC has four inputs and four outputs. Separate the PLC inputs and outputs laterally so that the inputs and outputs are not superimposed on the block diagram. This will make the block diagram clearer, easier to understand and much easier to draw. Show the necessary connections from the PLC to a relay bank with two relays. Each relay switches high power to each of two motors which run two vibrators under a conveyer belt. Show the high-power source on the block diagram.

Carefully draw the feedback loops which trip the motors whenever the temperature of the vibrators exceeds the set point set in the PLC program. Label the feedback loops.

Clearly distinguish low-power lines and components from high-power lines and components. Show ALL signal directions. In this examination question you need not show analogue-to-digital (ADC) or digital-to-analogue (DAC) conversions as process blocks. It will be accepted that those conversions will be done as software conversions programmed by you to operate within the PLC. Show how to connect a USB cable to download the program from your laptop to the PLC. (10)

1.2 Draw the circuit diagram of a 4 bit R/2R converter using an operational amplifier. Use 10 kilo-ohm and 20 kilo-ohm resistor values in the diagram. (7)

1.3 Give TWO advantages and ONE disadvantage of an R/2R converter. (3)

[20]

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QUESTION 2

2.1 Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'true' or 'false' next to the question number (2.1.1–2.1.5) in the ANSWER BOOK. Correct the statement if it is FALSE.

2.1.1 The instruction register holds only the operand address of the current instruction.

2.1.2 The program counter stores a count of all the programs stored in RAM.

2.1.3 Microsoft has full proprietary rights over Google's Android operating system.

2.1.4 Microsoft's Office suite is well known as open-source software.

2.1.5 Microsoft originated and developed the LINUX operating system.

(5 × 2) (10)

2.2 The International Electrotechnical Commission lists and defines programming languages under Open International Standard IEC 61131-3.

Draw up a numbered list of FIVE of these programming languages. Clearly show the programming format of each language (i.e. text or graphical). (5 × 2) (10)

[20]

QUESTION 3

3.1 Most computers use a bus structure or system to link the various components within a system.

Name THREE types of busses and make a sketch clearly showing the connections and directions of these three busses in a simple computer system. (8)

3.2 Logic systems based on digital computers have superseded operational amplifiers in many technological fields.

Give FOUR reasons why this has happened. (4)

3.3 Your manager has been asked to draw up a cost/benefit analysis regarding the replacing of an operational amplifier which controls the level of edible oil in a stainless steel tank. The alternative method of control is an up-to-date digital computer.

Draw a large, neat, fully labelled block diagram to show the interfacing of input/output ports of the computer.

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The computer is used to control the level of furnace oil in the tank. The labels of the block diagram must appear on the block diagram itself. Clearly show the configuration of each input/output port.

ALL interfacing and process functions needed to monitor and control the level must be shown. Show signal directions. Show the interfacing of sensor(s) and actuator(s). Label the feedback and action loops. (8)
[20]

QUESTION 4

4.1 Show with a simple sketch what contact bounce will look like on an oscilloscope and explain why it is necessary for a microprocessor to implement a de-bounce function while scanning the ASCII-code input which has come from keyboard keys. (4)

4.2 Neatly draw a complete keyboard diode-matrix circuit diagram so that striking each of the keys from A to F (NOTE: upper case letters) will produce the correct ASCII equivalent. Do NOT include a parity bit output. A = 41 BCD. (8)

4.3 Draw a complete, fully labelled block diagram of a parallel ADC (flash converter). List the decoding table for this converter. (8)
[20]

QUESTION 5

5.1 **Programming instruction procedure**

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)

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Note the following specification information when writing the program:

- ALL mathematical operations done before coding must be shown.
- The program counter is loaded with CAAA (hexadecimal) to begin the program.
- Case sensitivity: Operands must be lower case.
- Case sensitivity: Addresses must be upper case.
- You may NOT enlarge the instruction set.
- The program must stop processing if after any mathematical operation the contents of the accumulator are positive. (NOTE: positive)
- 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 F1B1
Operand s is stored in address F1B2
Operand t is stored in address F1B3
Operand u is stored in address F1B4 - and so on

The correct programming fields appear below:

INSTRUCTION LOCATION	**INSTRUCTION WORD**		**DESCRIPTION**
	OP-CODE	**ADDRESS**	

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

z = u(s + x + y) (10)

5.2 Give the use of FIVE open-source software packages. (5 × 2) (10)
[20]

TOTAL: 100

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