



higher education & training

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AUGUST EXAMINATION

NATIONAL CERTIFICATE

LOGIC SYSTEMS N6

(8080306)

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13:00–16:00

This question paper consists of 7 pages.

ENGINEERING

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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.

NOTICE TO CANDIDATES

The lives and safety of people depend on logic systems. Logic systems prevent lift doors from crushing persons to death. 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.

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QUESTION 1

1.1 Name the programming languages defined by the International Electrotechnical Commission under Open International Standard IEC 61131-3. Clearly show the programming format of each language (that is text or graphical). (10)

1.2 The program segment below is given in Instruction List (also commonly called ('Statement List'). The program allows MOTOR_1 to run for ten seconds (#100) before it is disconnected by TIMER_1. The values given in the VALUE column are (with the exception of the hexadecimal timer value) Boolean values (either 0 or 1). The values given in the table are the un-energised values before the circuit is switched on. Draw the ladder diagram format of this program segment. Place addresses above each component. Place comments under each component.

RUNG	STEP	INSTRUCTION	OPERAND	VALUE	COMMENT
0	0	LD	**A**	0	PUSHBUTTON ON_SWITCH
	1	OR	**Z**	0	MOTOR_1 (CONTACT)
	2	ANDNOT	**T0001**	0	TIMER CONTACT
	3	OUT	**Z**	0	MOTOR_1
1	4	LD	**Z**	0	MOTOR_1 (CONTACT)
	5	TIM	**0001**	0100Hex	TIMER_1
			#100		

(10)
[20]

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QUESTION 2

2.1 An electrician, Millwright or Logic Systems engineer must be able to use input and output ports to run external operations. It is also necessary to interface low-power logic systems control signals with high power current and voltage in order to perform external operations.

Draw a large, neat, fully labelled block diagram to show how you would use a USB to connect your laptop to a programmable logic controller (PLC) with four inputs and four outputs. This connection allows you to download a program from your laptop to the PLC.

Show the necessary connections from the PLC to a relay bank with two relays. Each of the relays switches high power to two motors which run two vibrators under a conveyer belt.

Carefully draw the feedback loops which trip the motors whenever the temperature of the vibrators exceeds the set point your have set in your PLC program. Show ALL signal directions. Clearly distinguish low power lines and components from high power lines and components. Label feedback loops.

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. (10)

2.2 Explain what is meant by 'open source software' and give TWO well-known examples of open source software. Is the Microsoft Office suite open source software? (5)

2.3 Explain what is meant by an 'Open International Standard'. (3)

2.4 Is there a difference between 'open source software' and an 'Open International Standard'? (2)
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QUESTION 3

3.1 During processing and before bottling, cod-liver oil has to be kept at set point level in a stainless steel tank. An operational amplifier configured as a comparator is used to control the level of the cod-liver oil in the tank.

Draw a large, neat, fully labelled block diagram of the entire system. Show the connections to sensor(s) and actuator(s) necessary to control the level. Show signal directions. Show any analogue-to-digital or digital-to-analogue converters that may be needed. (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 cod-liver oil in a stainless steel tank. The alternative method of control is an up-to-date digital computer.

Draw up a large, neat, fully labelled block diagram to show the interfacing of input/output ports of the computer. The computer is used to control the level of the cod-liver 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 Explain why the keyboard microprocessor must implement a debounce function while scanning the ASCII which has come from the 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. (8)

4.3 Draw a complete, fully labelled block diagram of a digital multimeter. Draw the required input blocks for all three of the DMM's basic functions. Give a short explanation of the method of operation of each of the THREE input circuits and also of the system as a whole. (8)

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QUESTION 5

5.1 The data bus is bidirectional.

Explain why the data bus is bidirectional by using the following headings:

5.1.1 Memory read

5.1.2 Memory write

(2 x 1) (2)

5.2 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)

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 is positive. (NOTE: POSITIVE).
- The correct delimiter must be used after delivering the output so that memory use is limited to program lines.

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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:
$z = u(t + u)$

(8)

5.3 Name and identify the use of each of FIVE well-known software packages which are based on OPEN SOURCE.

(10)
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TOTAL: 100

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