higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

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NOVEMBER EXAMINATION

NATIONAL CERTIFICATE

LOGIC SYSTEMS N6

(8080306)

19 November 2014 (Y-Paper)
13:00–16:00

Calculators may be used.

This question paper consists of 8 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. Substantiate your work and statements with authoritative and easily checkable website links where necessary.
5. 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 List the programming Languages defined by the International Electrotechnical Commission under Open International Standard IEC 61131-3. Clearly show the programming format of each language (i.e. text or graphical). (10)

1.2 The following diagram (page 4) shows the ladder diagram of a program segment. Tabulate the equivalent Instruction List (Statement List) program in your ANSWER BOOK. Show exactly what appears on the program workspace on your computer screen. In the VALUE column show Boolean values as un-energised values. Show the rung and step numbers which appear when the program is displayed in Instruction List format. Use the following programming fields:

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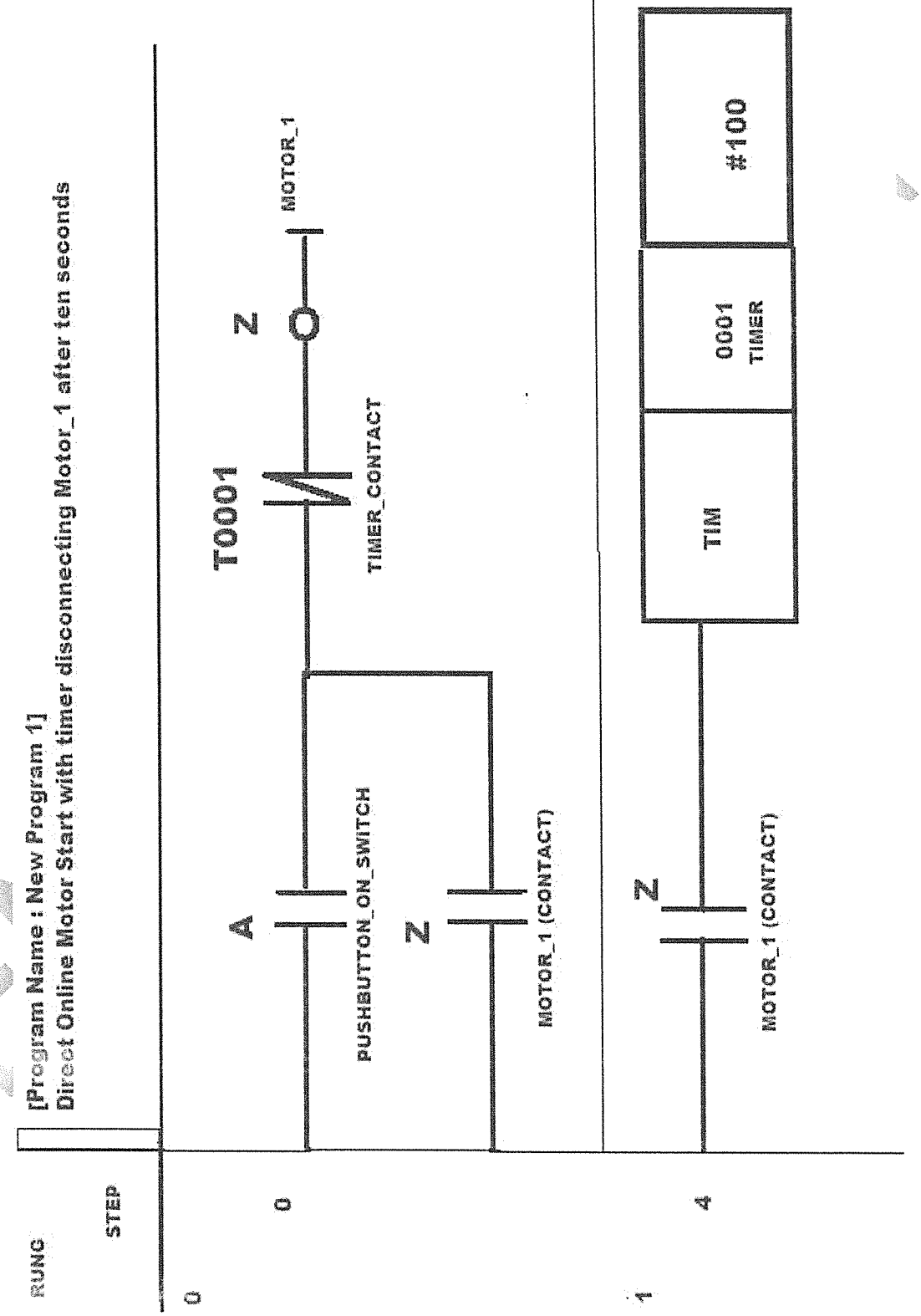
RUNG	STEP	INSTRUCTION	OPERAND	VALUE	COMMENT



(10)
[20]

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QUESTION 2

2.1 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 input and four outputs. This connection allows you to download your program from your laptop to the PLC. 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 cutting tools. Carefully draw the feedback loops which trip the motors whenever the temperature of the gearing which runs the cutting tools 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. 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 The software development industry has certain criteria which must be met in order for software to be considered 'OPEN SOURCE'. Draw up a numbered list of FIVE of these criteria. (5)

2.3 Draw up a numbered list of FIVE high-level programming languages. (5)

[20]

QUESTION 3

Indicate whether the following statements are TRUE or FALSE. Write only 'true' or 'false' next to the question number (3.1–3.10) in the ANSWER BOOK. Give a short explanation to support your answer.

3.1 Microsoft has proprietary rights over Google's ANDROID operating system.

3.2 Microsoft's Office suite is Open Source Software.

3.3 Microsoft created and developed the LINUX operating system.

3.4 During the READ cycle data is read from the accumulator.

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

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

3.7 Computer operations are synchronised with the system-clock oscillator.

3.8 Both machine-code and assembler are classified as LOW-LEVEL languages.

3.9 The accumulator stores ongoing results of computations.

3.10 When a JUMP instruction is carried out, the program counter is loaded with the address of the instruction which is being jumped to.

(10 x 2) **[20]**

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QUESTION 4

4.1 Large-scale integration (LSI) is used to build digital multimeters. Use the following headings: INPUT CIRCUITS, PROCESSING CIRCUITS, OUTPUT CIRCUITS. Describe the integrated-circuit functions. Say whether those functions are analogue or digital. State where IC op amps (operational amplifiers) are used. Describe any hybrid circuits. (8)

4.2 Interfacing input/output ports to run real-time applications can result in unexpected problems. A methodical approach is necessary. Draw a large, neat, fully labelled block diagram to show the interfacing of input/output ports of a computer. The computer is used to control the level of non-volatile oil in a 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. (6)

4.3 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	Brings 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 specific information when writing the program:

The first instruction address with which the program counter is loaded is AAAA (Hexadecimal)

- All mathematical operations done before coding must be shown.
- 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:

$z = u(t + u)$ (6)
[20]

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QUESTION 5

5.1 Many Digital-to-Analogue (D/A) converters use operational amplifiers. There are significant differences in the way these operational amplifiers are used to effect the required conversions and to do other tasks. Bear this in mind as you answer the following questions:

5.1.1 Sketch a series D/A converter. (5)

5.1.2 Draw the input and output waveforms for the series D/A converter. (2)

5.1.3 Describe the operation of a series D/A converter. (3)

5.2 Name and identify the use of FIVE well-known software packages which are based on OPEN SOURCE. (10)
[20]

TOTAL: 100

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