higher education & training

Department:
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REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

STORED PROGRAMME SYSTEMS
NQF LEVEL 3

(10040103)

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

This question paper consists of 5 pages.

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DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)
STORED PROGRAMME SYSTEMS
NQF LEVEL 3
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 black or blue pen.
5. Diagrams and drawings should be clear and neat. A pencil may be used.
6. Write neatly and legibly.

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QUESTION 1

1.1	Explain the meaning of the term *automatic control*.	(1 × 2)	(2)
1.2	State FOUR functions of a programmable logic controller.	(4 × 1)	(4)
1.3	Draw a block diagram that represents a simple control system.	(3 × 1)	(3)
1.4	Draw a pictorial drawing of an electric motor connected to a PLC via a contactor having start and stop push buttons.	(6 × 1)	(6)

[15]

QUESTION 2

2.1	2.1.1	Are sensors *input field devices* or *output field devices*?		
	2.1.2	Give ONE reason for the answer to QUESTION 2.1.1.	(2 × 1)	(2)
2.2		Show by means of a fully labelled IEC drawing, how a 2-wire (NO) inductive proximity sensor is connected to a PLC unit.	(3 × 1)	(3)
2.3		Explain the difference between a *contact-type sensor* and a *non-contact-type sensor*.	(2 × 2)	(4)
2.4	2.4.1	When working with PLC source code, enabling and time-based conditions are used. Is the enabling condition a physical input or an output? Motivate your answer.	(1 × 2)	(2)
	2.4.2	Identify TWO time-based conditions that may be encountered in a PLC source code.	(1 × 2)	(2)
2.5		Name THREE common types of input signals that can be encountered in modern PLC-controlled applications.	(3 × 1)	(3)
2.6		Draw a fully labelled drawing showing the construction of a proximity sensor.	(4 × 1)	(4)

[20]

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QUESTION 3

3.1 Why is it important to produce documentation when designing a PLC-controlled application? (1 × 2) (2)

3.2 Explain the purpose of the *PLC address allocation list*. (1 × 2) (2)

3.3 Explain why it is important to include a linking device between the PLC output interface and that of the working load. (1 × 2) (2)

3.4 3.4.1 Draw a fully labelled PLC connection diagram that enables control of the application shown in the FIGURE 1 below. Use IEC symbols.

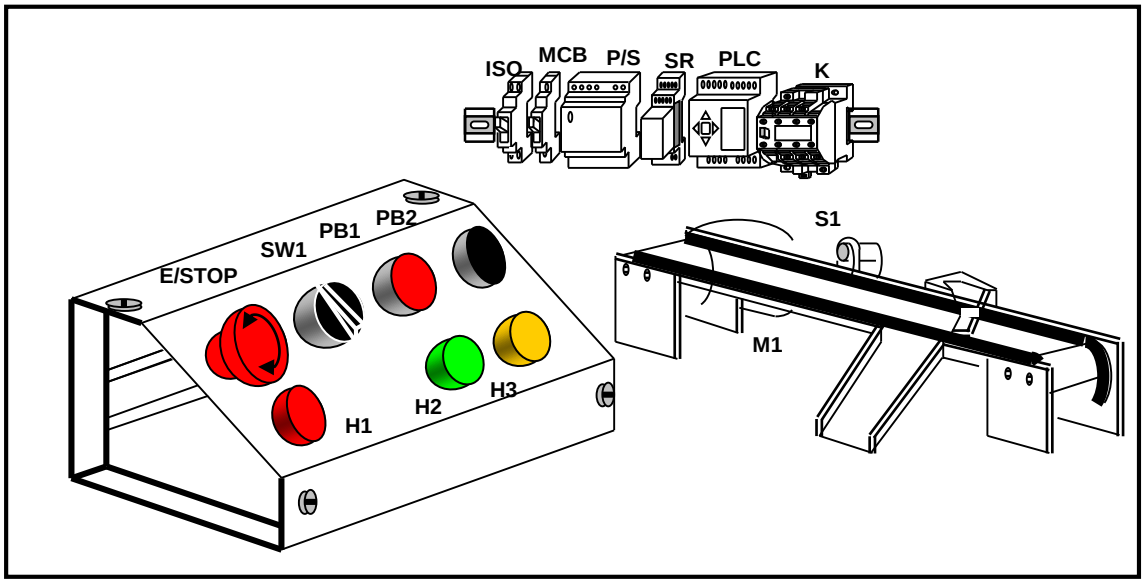


FIGURE 1 (8 × 1) (8)

3.4.2 Draw a fully labelled working single-line diagram with the motor being controlled having a 3-phase supply. Show voltage and current ratings. (6 × 1) (6)

[20]

QUESTION 4

4.1 Name FOUR basic switching logic functions that would be used to create a PLC source code control program. (4 × 1) (4)

4.2 Explain how the sequence function chart (SFC) can be used as a design tool for programming a PLC. (1 × 2) (2)

4.3 Refer to the FIGURE in QUESTION 3.4.1 and write NETWORK 1 of a PLC source code in PLC ladder to meet the following outcomes:

Outcomes:
The RED hazard lamp (E1) must flash when the emergency stop push-button relay is de-energised, using two timers. (9 × 1) (9)

4.4 Refer to FIGURE 1 and write NETWORK 2 of a PLC source code in PLC ladder to meet the following outcomes:

Outcomes:

- When the system is energised, the GREEN indication lamp (H2) must be illuminated.
- When the start push button (Pb1) is activated, the GREEN indication lamp (H2) must go out and the RED indication lamp (H3) must be illuminated.
- When the stop push button (Pb2) is activated, the RED indication lamp (H3) must be de-energised and the GREEN indication lamp must be illuminated. (6 × 1) (6)

4.5 Explain the rule related to the emergency stop and PLC operation. (1 × 2) (2)

4.6 The EN 61131-1 PLC standard has basic requirements.

State SEVEN of these requirements. (7 × 1) (7)

[30]

QUESTION 5

5.1 State SIX steps in the systematic approach to troubleshooting PLC-related faults. (6 × 1) (6)

5.2 Explain and draw a diagram to show how a photoelectric thru-beam fork proximity sensor is tested for operation out of circuit. (6 × 1) (6)

5.3 Identify THREE visual inspection checks in PLC electrical sub-systems. (3 × 1) (3)

[15]

TOTAL: 100

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