higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

STORED PROGRAMME SYSTEMS
NQF LEVEL 3

(10040103)

14 November 2019 (X-Paper)
09:00–12:00

This question paper consists of 8 pages.

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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. ALL drawings must be correctly labelled.
5. ALL terminations must be numbered.
6. IEC symbols must be used at ALL times.
7. Write neatly and legibly.

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QUESTION 1

1.1 What is the function of a programmable logic controller as used in the automated industry? (2)

1.2 Study FIGURE 1 of a PLC system.

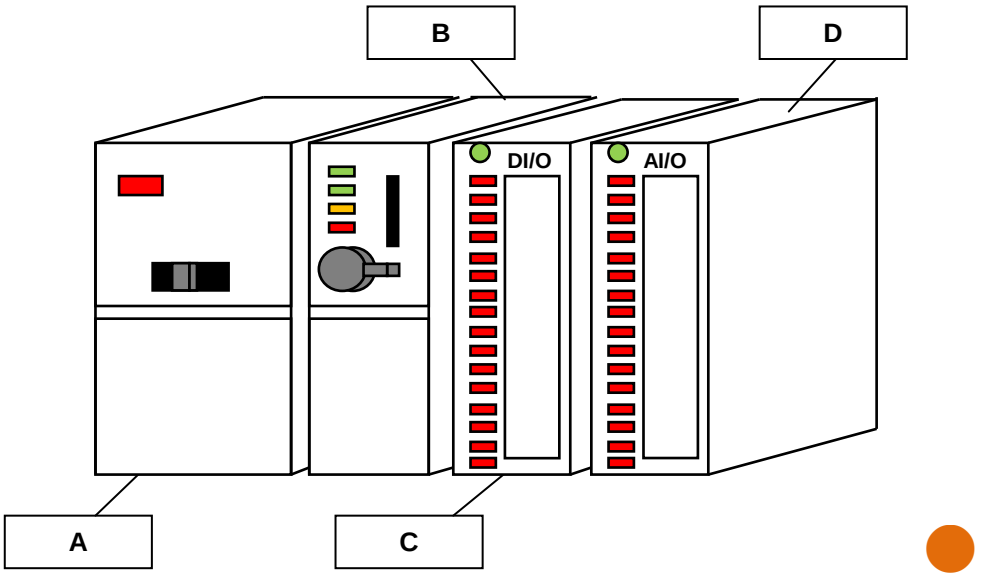


FIGURE 1

1.2.1 What kind of PLC system is shown in FIGURE 1?

1.2.2 What is represented by the unit A?

1.2.3 What is represented by the unit B?

1.2.4 What is represented by the unit C?

1.2.5 What is represented by the unit D?

(5 × 1) (5)

1.3 Draw a systems diagram that will represent a PLC automated system. (6)

1.4 Explain the difference between the *brick* and *modular* type PLC system with respect to cost. (2)

[15]

QUESTION 2

2.1 Explain what is meant by a *proximity type sensor*. (2)

2.2 Explain what is meant by a *measurement type sensor*. (2)

2.3 Explain what is meant by a *pressure type sensor*. (2)

2.4 Name TWO types of proximity type sensors. (2)

2.5 Show by means of a simplified drawing the operation of a 'thru-beam' photo electric sensor. (4)

2.6 Show by means of a simplified drawing the operation of a 'retro-reflective' photo electric sensor. (4)

2.7 Explain the difference in operation between that of the *thru-beam* and that of the *retro-reflective* photo electric sensors. (4)

[20]

QUESTION 3

3.1 Study the materials and address allocation list shown in FIGURE 2.

ITEM	DESCRIPTION	MARKING	APPLICATION	ADDRESS
1	Switch detent (NO)	SW1	Turn system on/off	N/A
2	Mushroom head detent (NC)	SW2	Emergency stop	N/A
3	Safety Relay 24V	SR	Safety relay	N/A
4		SR	Contact set 1(11/12)	I1
5		SR	Contact set 2 (23/24)	Q4
6	Motor Control Relay 24V	R1	Contact set 1 (13/14)	N/A
7	Push button (NO)	Pb-1	Start Process	I2
8	Push button (NC)	Pb-2	Stop Process	I3
9	Indication lamp RED 24V	H1	Hazard warning flashing	Q1
10	Indication lamp GRN 24V	H2	Standby indication	Q2
11	Indication lamp AMB 24V	H3	Run indication	Q3
12	Power supply 220V/24V:1.3A	P/S	Control & Drive voltage	N/A
13	PLC “logo” 8I/4O R	PLC	Monitor and control	N/A
14	Logo Ext Module 4I/4O	EXT		N/A
15	Circuit breaker 2A	CB	Protect Wiring	N/A
16				
17				

FIGURE 2

3.1.1 Explain what the function of a materials and address allocation list is. (2)

3.1.2 List FOUR other forms of documentation required when designing and installing a PLC controlled application. (4)

3.1.3 Explain how the safety relay is to be used in a PLC controlled application. (2)

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3.1.4 Using the material and address allocation list shown in FIGURE 2, give the designation/markings of:

(QUESTION 3.1.4.1–3.1.4.12) shown in FIGURE 3.

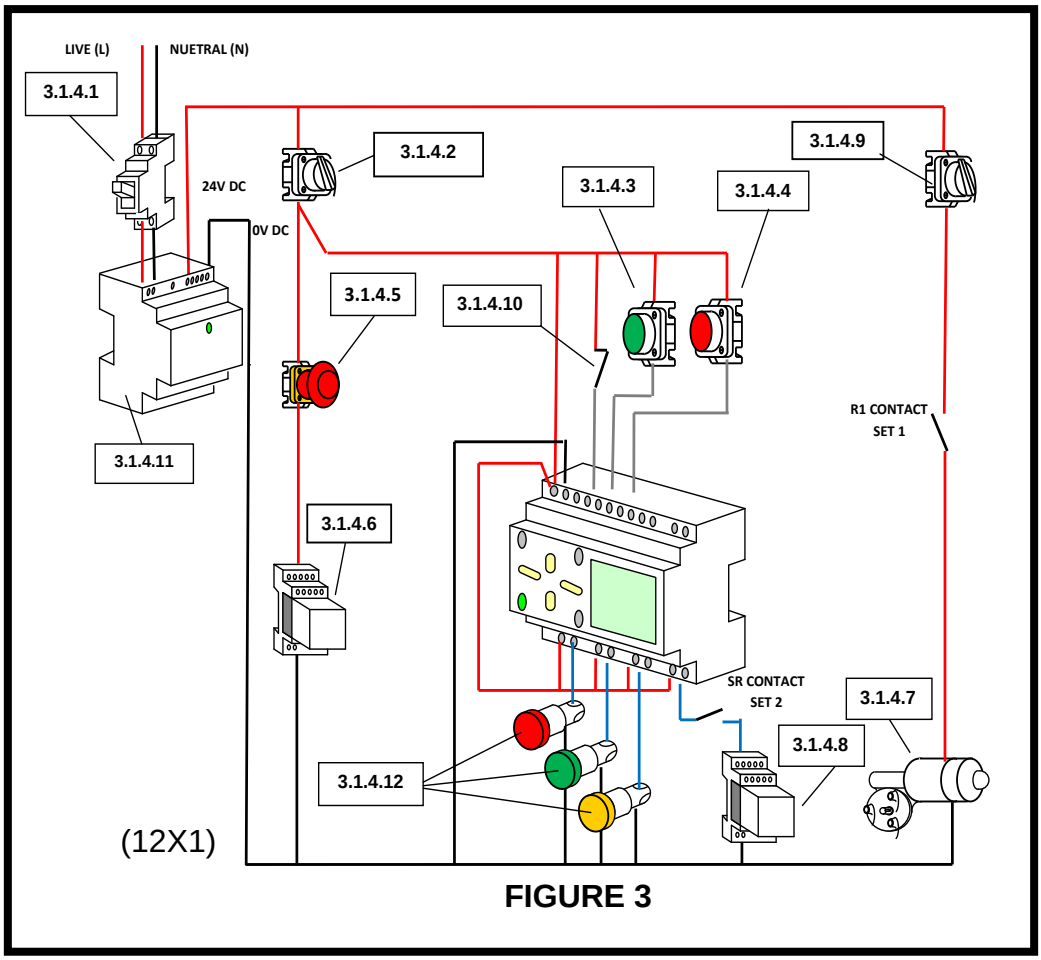


FIGURE 3

(12)
[20]

QUESTION 4

4.1 Using the information given in QUESTION 3, write a PLC LAD program to meet the following outcomes according to the machine standard related to PLC and E/STOP.

- The DC motor must stop when the emergency stop mushroom head push button is activated and the red hazard light must flash (without turning off the supply to the PLC) until the E/stop is reset.
- Once the system is energised, the green indication standby lamp must illuminate.
- Once the start push button is activated, the red run indication lamp must energise, the green standby lamp must go out and the DC motor must run.
- Once the stop push button is activated, the motor must stop, the run indication must go out and the standby indication must turn on. (15)

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4.2 Explain the fundamental difference between using cascaded and sequential virtual timers. (2 × 2) (4)

4.3 Sequential function charts (SFCs) are used for designing PLC code.

List the THREE main parts that make up a sequence function chart. (3)

4.4 List the FOUR areas used when writing a PLC code using instruction list (IL). (4)

4.5 Explain what a *virtual input* is when writing a PLC program. (2)

4.6 Name TWO special relays that do not have physical outputs used in a PLC application program source code. (2)

[30]

QUESTION 5

5.1 Study FIGURE 4 showing the wiring and components of the modular PLC controlled conveyor motor.

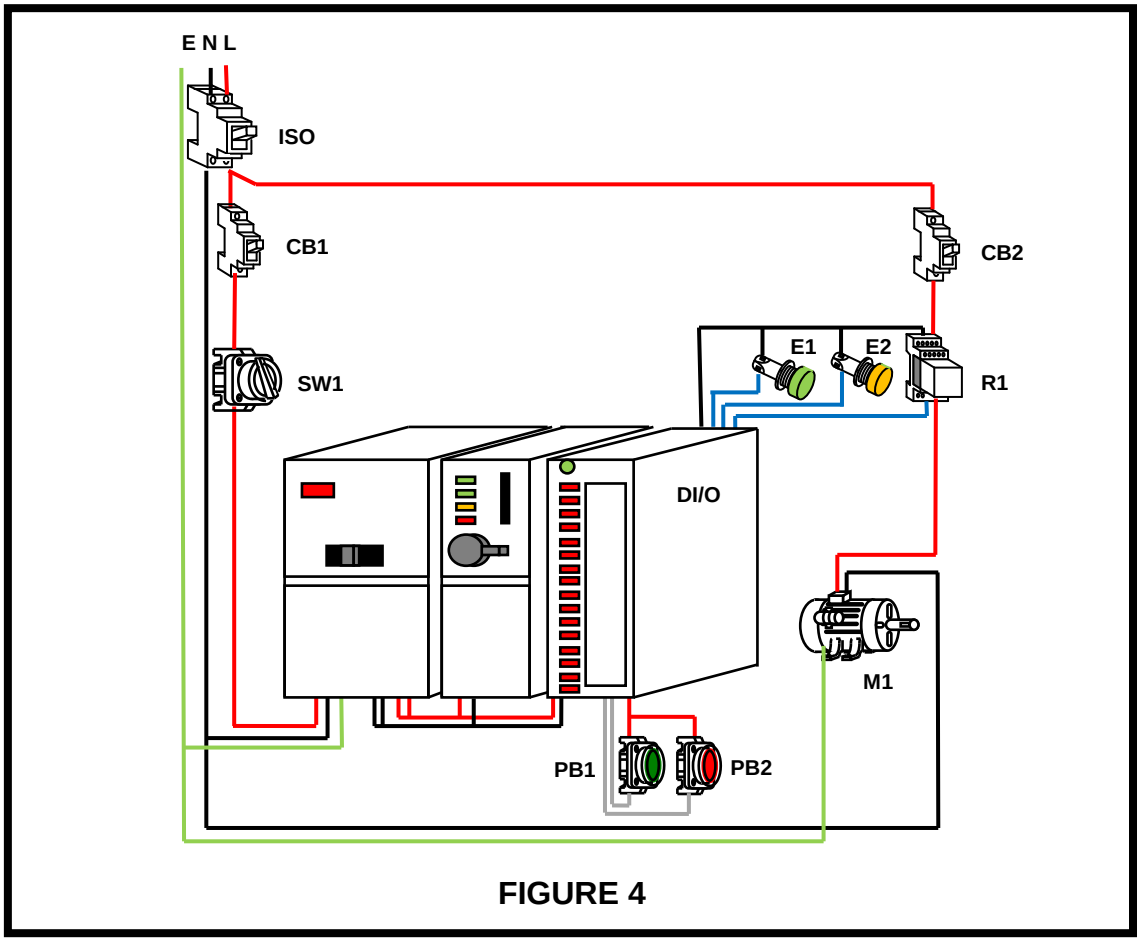


FIGURE 4

5.1.1 What is the problem when CB1 trips when the control circuit is turned on? (2)

5.1.2 Explain what you would do to solve the problem identified in QUESTION 5.1.1. (2)

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5.1.3 The CPU does NOT energise when CB1 is activated. After further investigation it is established that power supply 'power on LED' is energised.

Explain how using a troubleshooting flowchart the 'output-input-through the circuit approach can be used to solve the problem. (4)

5.1.4 When CB1 is activated the PLC subsystem does not energise. Explain a possible cause when the 'power on LED' does not light up on activation. (2)

5.1.5 Explain what you would do to solve the problem identified in QUESTION 5.1.4. (2)

5.2 List THREE reasons for commissioning an automated system using PLC. (3)
[15]

TOTAL: 100

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