higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

STORED PROGRAM SYSTEMS
NQF LEVEL 3

(10040103)

3 March 2020 (X-Paper)
09:00–12:00

This question paper consists of 7 pages.

243Q1S2003

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TIME: 3 HOURS
MARKS: 150

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

FIGURE 1 shows a modular type PLC system.

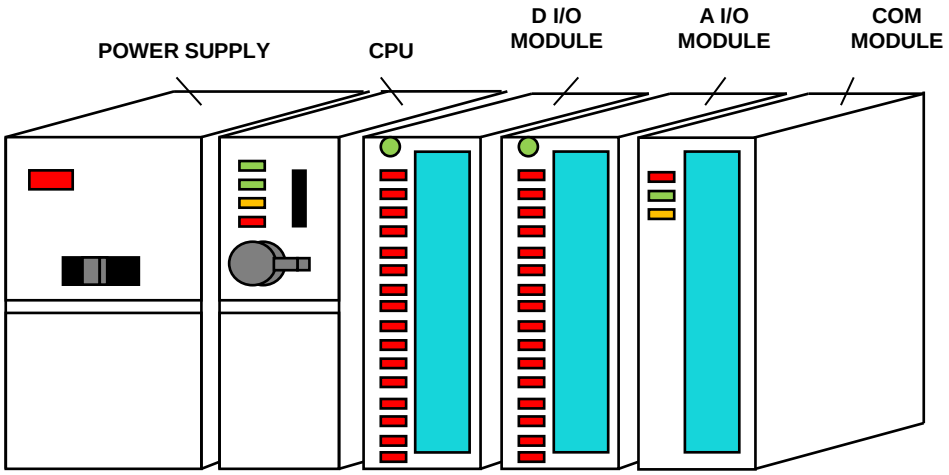


FIGURE 1

Answer the following related questions.

1.1 What is the purpose of the power supply? (1 × 2) (2)

1.2 List THREE subsections that make up the CPU. (3 × 1) (3)

1.3 Draw an opto-isolating input that will represent one input of the digital input/output module. (4 × 1) (4)

1.4 Draw a relay output that will represent one output of the digital input/output module. (4 × 1) (4)

1.5 Explain what the purpose of the communications module is. (1 × 2) (2)

[15]

QUESTION 2

2.1

The Joint International Standard (JIS) and the International European Commission (IEC) generically names to all sensors that provide non-contact detection of target objects that are close by or within the general vicinity of the sensor, proximity switches, and classifies them as inductive, capacitive, ultrasonic, photoelectric, magnetic, etc.
Proximity sensors convert information on the movement or presence of an object into an electrical signal.

Answer the following related questions.

2.1.1 What is the name of the sensor that detects metal objects? (1 × 1) (1)

2.1.2 Explain the operation of the sensor that detects metal objects. (1 × 2) (2)

2.1.3 What is the name of the sensor that detects metal and non-metal objects? (1 × 1) (1)

2.1.4 Explain the operation of the sensor that detects metal and non-metal objects. (1 × 2) (2)

2.1.5 What is the name of the sensor that uses a magnet to detect the presence of an object? (1 × 1) (1)

2.1.6 Explain the operation of the sensor that uses a magnet to detect the presence of an object. (1 × 2) (2)

2.2 Proximity sensors include all sensors that perform non-contact detection in comparison to sensors, such as limit switches, that detect objects by coming into physically contact with them.

Answer the following related questions.

2.2.1 Name TWO advantages of using a limit switch.

2.2.2 Name TWO disadvantages of using a limit switch.

(2 × 2) (4)

2.3 Draw a fully labelled block diagram of an inductive sensor system. (Not the inductive sensor symbol) (7 × 1) (7)

[20]

QUESTION 3

3.1 FIGURE 2 shows a conveyor belt system connected to a PLC controller for control.

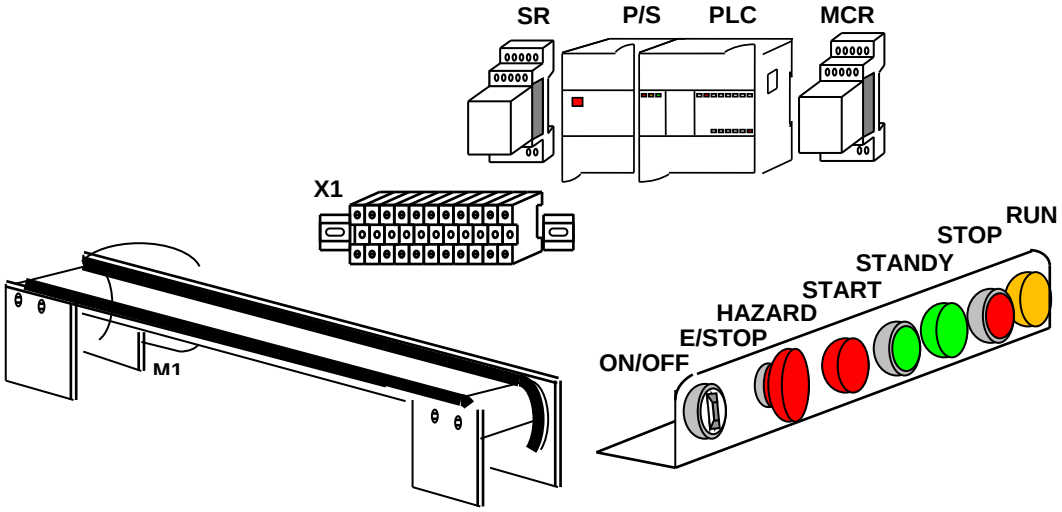


FIGURE 2

Draw the electrical connection diagram of the PLC.

(10 × 1) (10)

3.2 Explain the purpose of the electrical connection diagram. (1 × 2) (2)

3.3 Explain the purpose of the emergency stop mushroom head push button. (1 × 2) (2)

3.4 Explain how the emergency stop operates when working in conjunction with a safety relay and a PLC controlled application. (3 × 1) (3)

3.5 List THREE drive actuators used in PLC automated applications. (3 × 1) (3)

[20]

QUESTION 4

4.1 Study the PLC control code used in an automated PLC application shown in FIGURE 3.

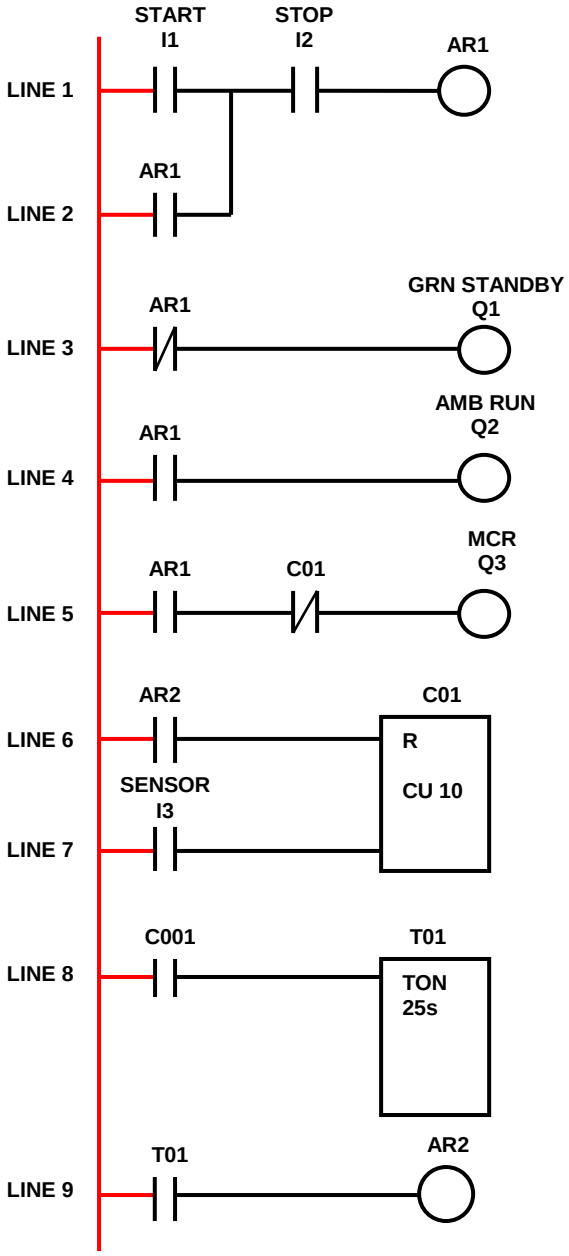


FIGURE 3

Answer the following related questions.

4.1.1 The virtual special relay (AR) has different characteristics to that of a virtual output (Q) coil.

Explain this difference. (2 × 2) (4)

4.1.2 Name TWO other special virtual relays used in this application PLC control code. (2 × 1) (2)

4.1.3 Explain the purpose of program lines (1–5)? (5 × 1) (5)

4.1.4 What is the purpose of the virtual contact (C01) in line 5? (1 × 2) (2)

4.1.5 What is the purpose of the sensor virtual contact (I3) in line 7? (1 × 2) (2)

4.1.6 What is the purpose having line 9 in the application PLC control code? (1 × 2) (2)

4.1.7 What is the purpose of the timer (T01) in the application PLC control code? (1 × 2) (2)

4.1.8 Write down the summary of operation of the PLC application control code given a FIGURE 3. (5 × 1) (5)

4.2 With the aid of a piece of PLC control code, show how virtual cascaded timers can be used to turn on three motor control relays in a positive sequence having 10 second starting intervals. (6 × 1) (6)

[30]

QUESTION 5

5.1 Troubleshooting requires out of the box thinking to solve automated PLC related malfunctions, therefore knowledge of various aspects of the controlled application is required to be known.

List SIX related items of knowledge and abilities required to troubleshoot a PLC automated application. (6 × 1) (6)

5.2 Explain how the THREE diagnostic indicators will assist one in trouble-shooting a PLC central processing unit. (3 × 1) (3)

5.3 Explain with the aid of a drawing how the output LEDs can assist one to determine whether a PLC program fault or field device is malfunctioning. (4 × 1 + 1 × 2) (6)

[15]

TOTAL: 100

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