higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE (VOCATIONAL)

STORED PROGRAM SYSTEMS
NQF LEVEL 3

3 March 2020

This marking guideline consists of 7 pages.

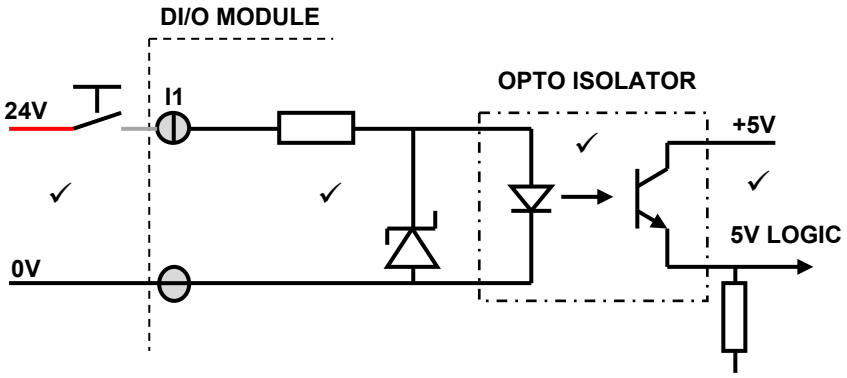
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QUESTION 1

1.1 1.1.1 The power supply is used to convert high AC voltage to low DC voltage safe for use in the control side of a PLC automated application. (1 × 2) (2)

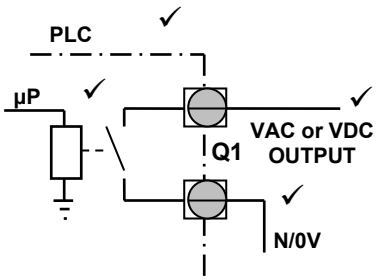
1.1.2
- Arithmetic logic unit (ALU)
- Memory unit (ROM & RAM)
- Power supply (3 × 1) (3)

1.1.3



(4 × 1) (4)

1.1.4



(4 × 1) (4)

1.1.5 The communication module enables networked communication using various communication medium and protocols in a PLC controlled application.✓✓ (1 × 2) (2)

[15]

QUESTION 2

2.1 2.1.1 Inductive sensor (1 × 1) (1)

2.1.2 When the metal target enters and disrupts the balanced resonant electromagnetic fields an output signal is generated.✓✓ (1 × 2) (2)

2.1.3 Capacitive sensor (1 × 1) (1)

2.1.4 When the target enters the balanced resonant electrostatic fields an output signal is generated.✓✓ (1 × 2) (2)

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2.1.5 Magnetic sensor. (1 × 1) (1)

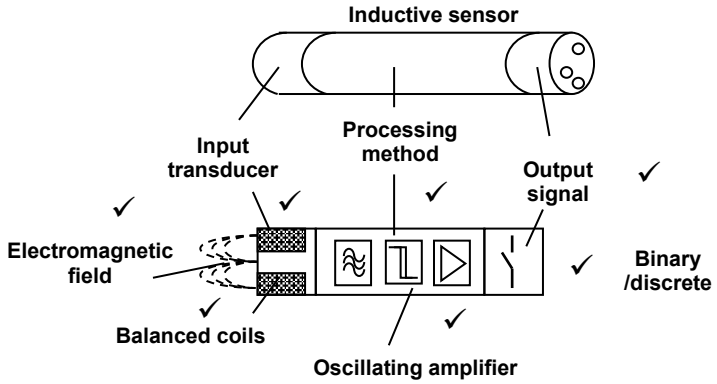
2.1.6 The magnetic sensor is made up of a magnet and a normally open or closed reed switch contact which will be closed or opened respectively when the magnet is brought into close proximity.✓✓
(1 × 2) (2)

2.2 2.2.1 Limit switch advantages
The mechanical advantages of limit switches are:
- Ease-of-use
- Simple visible operation
- Durable housing
- Properly sealed for reliable operation
- High resistance to different ambient conditions found in industry
- High repeatability
- Positive opening operation of contacts (some models)

The electrical advantages of limit switches are:
- Suitable for switching higher power loads than other sensor technologies (5A at 24V DC or 10A at 120V AC typical vs. less than 1A for proximities or photo-electrics)
- Immunity to electrical noise interference
- Immunity to radio frequency interference (walkie-talkies)
- No leakage current
- Minimal voltage drops
- Simple normally open and/or normally closed operation
(Any 2 × 1)✓✓ (2)

2.2.2
- Shorter contact life than solid-state technology
- Moving mechanical parts eventually wear out
- Not all applications can use contact sensing
- Contact bounce can occur (Any 2 × 1)✓✓ (2)

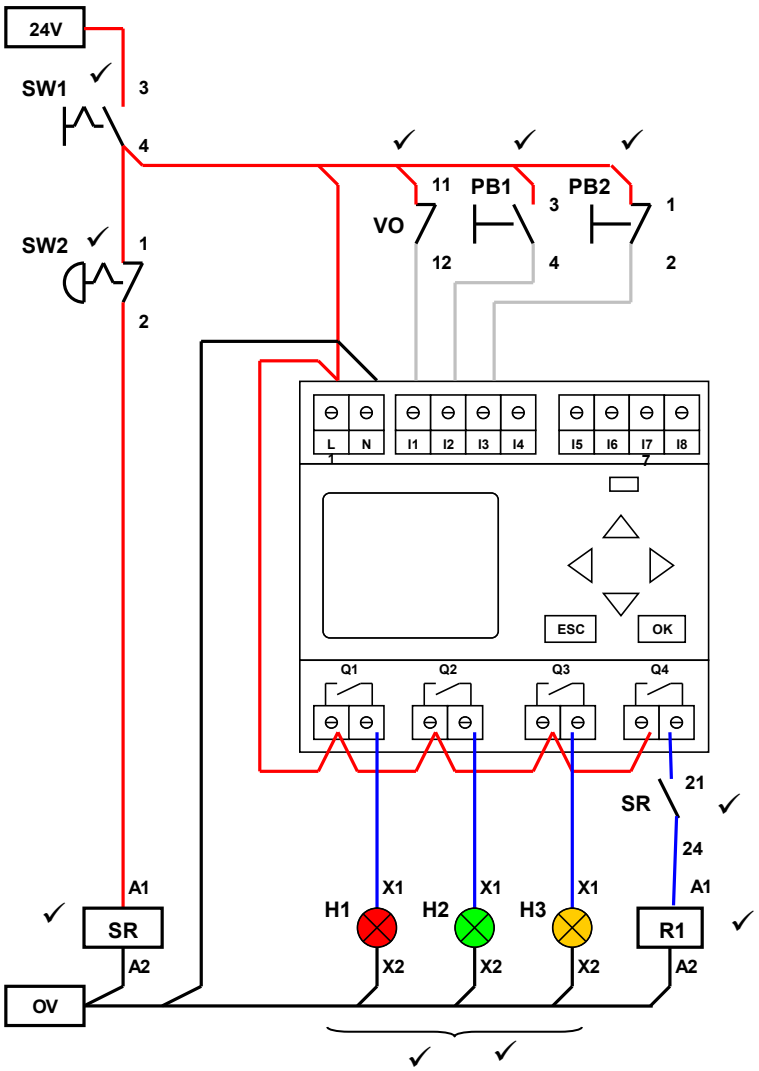
2.3



(7 × 1) (7)
[20]

QUESTION 3

3.1



Full marks if fully labeled with designation and terminal numbering.

(10 ×1) (10)

3.2 The electrical wiring diagramme is used to ensure that the PLC application I/O's wiring is connected to the correct components, terminals and PLC addresses.✓✓ (1 × 2) (2)

3.3 The red, mushroom-head emergency stop push button forms part of the safety circuit and is operated when a hazard is evident, breaking supply to the drives.✓✓ (1 × 2) (2)

3.4 The emergency stop push button (E/Stop) is an NC switch that enables the safety relay (SR) to be energised when the system is turned on.✓ When the E/Stop is activated the SR will de-energise, thus enabling the supply to remain on the PLC✓ and de-energises the drive control actuator, thus breaking the supply to the drive.✓ (3 × 1) (3)

3.5
- Contactors
- Solenoid valves
- Relays (3 × 1) (3)

[20]

QUESTION 4

4.1 4.1.1 The output coil (Q) has physical outputs✓✓ whereas the special auxiliary relay (AR) has no physical output from the PLC.✓✓ (2 × 2) (4)

4.1.2
- Timers
- Counters (2 × 1) (2)

4.1.3 Line 1 – I1 used to start the application and I2 is used to stop the application
Line 2 – AR1 is used to latch on the AR1 relay coil
Line 3 – NC AR1 contact used to control the green standby indication lamp via output coil Q1
Line 4 – NO AR1 contact used control the amber indication lamp via output coil Q2
Line 5 – NO AR1 contact used to control the motor control relay Q3 via counter C01 NC contact (5 × 1) (5)

4.1.4 Line 5 – Contact C01 is used to turn the MCR output coil (Q3) off when the pre-set count value has been reached, and back on again when the counter has been reset.✓✓ (1 × 2) (2)

4.1.5 Line 7 – Virtual contact of I3 is used to count the work pieces, which is used as input count to counter C01.✓✓ (1 × 2) (2)

4.1.6 Line 9 – Virtual contact T01 is used to energise special relay AR2, which will reset counter C01.✓✓ (1 × 2) (2)

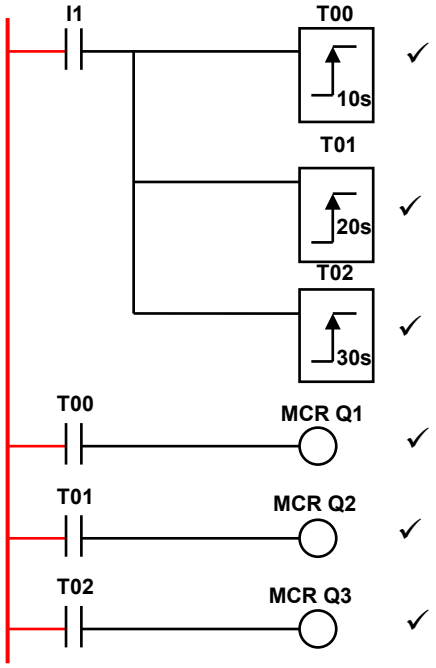
4.1.7 Line 8 – Timer T01 is used to enable the counter to stay energised for a pre-set time.✓✓ (1 × 2) (2)

4.1.8
- When the PLC system is energised the green indication standby lamp Q1 will energise.
- When the start pb1 (I1) is activated the green standby lamp (Q1) will de-energise and the amber run lamp (Q2) will energise and the motor control relay (Q3) will energise.
- The sensor (I3) will count (CO1) work pieces to a pre-set value – once the pre-set value has been reached the MCR (Q3) will de-energise.
- The MCR (Q3) will energise once a pre-set time TO1 has been reached, resetting CO1.
- When the stop pb2 (I2) is activated the system will stop and return to the standby mode with Q1 energised.

MARKER TO USE DISCRETION (5 × 1) (5)

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4.2



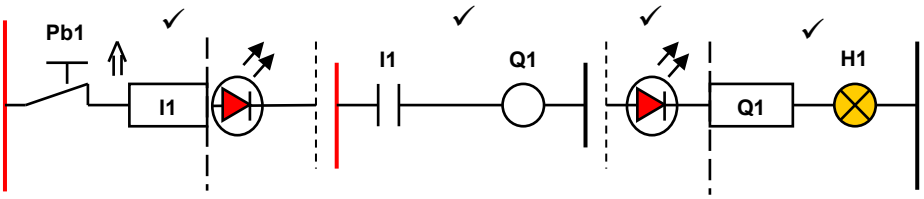
MARKER TO USE DISCRETION (6 × 1) (6)
[30]

QUESTION 5

5.1
- Knowledge of symbols, terminations and functions of components
- Knowledge of how to read circuit diagrammes and terminal lists
- Knowledge of the various energy supply types
- Knowledge of how tools and test equipment work
- Knowledge of the operation of the system or sub system being tested
- Knowledge of the control system method used
- Knowledge of the networking medium and protocol being used
- Ability to apply troubleshooting and out-of-the-box thinking (Any 6 × 1) (6)

5.2
- RED power LED – relates to the power being available
- AMBER diagnostic LED – relates to the operation of the PLC unit
- GREEN communication LED – relates to the communication system in use (3 × 1) (3)

5.3 The PLC output interface has status LED indicators that provide useful checking information. When illuminated, the output LED indicates that the program is working fine – however, if the output is not energised the fault lies with the wiring or related components.✓✓



(1 × 2 + 4 × 1) (6)
[15]

TOTAL: 100

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