higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

MECHATRONIC SYSTEMS
NQF LEVEL 2

(6040102)

22 November 2024 (Y-paper)
13:00–16:00

This question paper consists of 4 pages.

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DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)
MECHATRONIC SYSTEMS
NQF LEVEL 2
TIME: 3 HOURS
MARKS: 100

INSTRUCTIONS AND INFORMATION

1. Read all the questions carefully.
2. Answer all the questions.
3. Number the answers according to the numbering system used in this question paper.
4. Start each question on a new page.
5. Use fully labelled IEC symbols.
6. Write neatly and legibly.

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QUESTION 1

1.1 Draw a simplified technical block diagram showing energy, information and material flow using the correct arrowhead-related flow lines. (4)

1.2 List EIGHT forms of information that can be found on a mechatronic system diagram. (8)

1.3 Draw a neat fully labelled simplified block diagram that will represent closed-loop control. (6)

1.4 Explain what you understand about energy conversion. (2)

[20]

QUESTION 2

2.1 Draw a neat fully labelled circuit representing direct control using IEC symbols. (2)

2.2 Draw a neat fully labelled circuit diagram representing indirect control. (2)

2.3 Draw a neat fully labelled drawing of a 24 V relay with a four changeover contact set arrangement. (6)

2.4 Briefly explain what is meant by remote control in mechatronic system applications. (2)

2.5 What is meant by employing safety voltage in a mechatronic control circuit? (2)

2.6 What is meant by intrinsic safety? (2)

2.7 List THREE components that learnt about in mechatronic systems that are used to generate a feedback signal on the status of a machine. (3)

2.8 What component is commonly used to give status of the mechatronic system to the operator? (1)

[20]

QUESTION 3

3.1 List the THREE subsystems found in a pneumatic system. (3)

3.2 What is used to distribute the pressurised air in a pneumatic application? (1)

3.3 What component controls the on/off flow of air in a pneumatic application? (1)

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3.4 Explain the purpose of the spool used in a pneumatic valve. (2)

3.5 An emergency stop has to be included in a pneumatic application.

List FOUR considerations that are necessary for the design. (4)

3.6 Draw a neat fully labelled energy flow block diagram of a pneumatic system. (5)

3.7 A two-handed AND control circuit for an unprotected embossing machine has to be designed.

Draw the manually operated circuit using IEC symbols for the embossing machine. (4)

[20]

QUESTION 4

4.1 What is the purpose of an emergency stop in a mechatronic electro-pneumatic application? (3)

4.2 Draw a neat fully labelled sketch of an emergency stop control circuit using IEC symbols that can be used with electro-pneumatic applications.

The following components are to be used: NO detent pushbutton, NC detent push button with mushroom head and a safety relay. (7)

4.3 Draw the labelled IEC symbol of the selector switch used to select automatic and manual control in an electro-pneumatic application. (2)

4.4 Using neat diagrams, explain the difference between direct and indirect control of a solenoid valve. (6)

4.5 Calculate the current flowing through a solenoid valve having a coil resistance of 48 Ω and is supplied by a 24 V DC source. (2)

[20]

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QUESTION 5

5.1 Explain the troubleshooting procedure to follow when using the 'output-input-through-the-circuit' method using a hose pipe. (3)

5.2 Draw up a broad flow chart that can be used to represent the 'output-input-through-the-circuit' troubleshooting approach on an electro-pneumatic control circuit. (9)

5.3 What is the purpose of troubleshooting mechatronic systems? (3)

5.4 What precaution must one take when doing dead circuit testing on electro-pneumatic systems? (2)

5.5 List THREE faults that may occur on the pneumatic subsystem of an electro-pneumatic system. (3)

[20]

TOTAL: 100

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