higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

MECHATRONIC SYSTEMS
NQF LEVEL 3

(6040213)

9 March 2018 (X-Paper)
09:00–12:00

This question paper consists of 5 pages.

NCV

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. Write neatly and legibly.

NC(V)

QUESTION 1

1.1 The mechatronic system makes use of analogue-to-digital (A/D) converters and digital-to-analogue (D/A) converters.

1.1.1 Draw the symbol of the analogue-to-digital converter used as a data interface in a control system.

1.1.2 Draw the symbol of the digital-to-analogue converter used as a data interface in a control system.

(2 × 3) (6)

1.2 List THREE types of multivibrator circuits. (3)

1.3 Digital rotary converters are known as encoders and are used to provide feedback in an automated system.

Give FIVE applications of a rotary converter in a mechatronic application. (5)

1.4 One of the forms of control used in control subsystems is the thyristor, which is used as an electronic switching device.

Explain the difference between the *gate current* and the *holding current* in relation to the switching on/off of a thyristor. (2 × 2) (4)

[18]

QUESTION 2

2.1 For servo-applications, induction motors need to be incorporated into a closed-loop system with some mechanism for velocity feedback by either a tachogenerator or a differentiated position-encoder signal.

List FIVE mechanisms that are used for speed variation control. (5)

2.2 Draw a labelled block diagram that will show how position feedback control is achieved in a servo-motor application. (8 × 1) (8)

2.3 Briefly explain the principle underlying the fundamental operation of the electric DC motor. (5 × 1) (5)

[18]

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QUESTION 3

3.1 Hydraulic and pneumatic applications are found in various technical systems.

Explain the difference between a *hydraulic system* and a *pneumatic system*.
(2 × 3) (6)

3.2 In a hydraulic application, it is required to activate a cylinder piston of a tool-holding device before the hydraulic spindle motor will rotate; in a machining process, the tool-holding device piston will only retract when the hydraulic motor has fully stopped.

Draw a hydraulic working circuit so as to perform the given sequence of the required function. (10 × 1) (10)

3.3 A hydraulic drive system is a drive or transmission system that uses pressurised hydraulic fluid to power hydraulic machinery.

Draw a labelled block diagram of the hydraulic system. (8 × 1) (8)
[24]

QUESTION 4

4.1 You are responsible for the maintenance of all the electro-hydraulic systems that use proportional control.

Proportional control is explained by using the example of an electric heater:

- Imagine the heater in your car being an actuator (output) which does the work of producing heat.
- The heater could be controlled by a computer and related program.
- Built into this system is the sensor which provides the feedback to the controller (computer) so that it knows the heater temperature is being maintained at a constant preset value.

Draw a labelled, closed-loop block diagram that explains the above process.
(10 × 1) (10)

4.2 In electro-hydraulic systems, valves are actuated via solenoids.

Explain the operation of the solenoid valve. (6 × 1) (6)

4.3 What is the purpose of the isolator with regard to replacing faulty components? (4 × 1) (4)
[20]

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QUESTION 5

5.1 Explain the procedure to be followed when removing a hydraulic cylinder. (6 × 1) (6)

5.2 The MCB keeps on tripping in an installation.

Briefly explain the possible fault that could exist. (2 × 1) (2)

5.3 It has been determined, by voltage measurement, that the output supply of the power supply is present but the system does not start.

Give SIX possible conditions that could exist so as to prevent start-up. (6 × 1) (6)

5.4 Explain the procedure that should be adopted when undertaking the logical fault diagnosis of a hydraulic system. (4 × 1) (4)

5.5 Explain how gas other than air may enter a hydraulic system. (2)

[20]

TOTAL: 100

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