higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

PROCESS CONTROL
NQF LEVEL 3

(6050403)

24 November 2023 (Y-paper)
13:00–15:00

This question paper consists of 7 pages.

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DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)
PROCESS CONTROL
NQF LEVEL 3
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. Use only black or blue pen.
5. Write neatly and legibly.

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SECTION A

QUESTION 1

Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'True' or 'False' next to the question number (1.1–1.5) in the ANSWER BOOK.

1.1 Thermistors have a positive temperature coefficient.

1.2 Sight glass level gauge is an example of an indirect level measuring instrument.

1.3 The purpose of the bimetallic strip is to convert a temperature change into mechanical movement.

1.4 The purpose of the loss of flame interlock is to shut off fuel upon loss flame in the furnace.

1.5 P&IDs is an abbreviation for piping and instrument diagrams.

(5 × 1) **[5]**

QUESTION 2

Choose a term from COLUMN B that matches a description in COLUMN A. Write only the letter (A–N) next to the question number (2.1–2.10) in the ANSWER BOOK.

COLUMN A		COLUMN B	
2.1	A control system that does not need any human effort when the process is operating normally	A	derivative control
2.2	A control loop having a master slave controller	B	digital signal
2.3	Signals having two discrete levels	C	distillation column
2.4	A mechanical pressure sensor consisting of a one-piece, collapsible, seamless metallic unit with deep folds formed from thin-wall tubing with an enclosed spring to provide stability	D	proportional action
2.5	Control effort is proportional to the error in the control system	E	indirect level measuring device
2.6	The amount a unit length of a material lengthens or contracts with temperature changes	F	temperature
2.7	A device that extrapolates the level from the measurement of another variable	G	open loop control
2.8	A flow-measuring device using a disk that rotates and wobbles in response to the flow	H	nutating disc meter
2.9	The degree or intensity of heat measured on a definite scale	I	bellows
2.10	A primary flow element consisting of a thin circular metal plate with a sharp-edged round hole in it and a tab that protrudes from the flanges	J	orifice plate
		K	coefficient of linear expansion
		L	cascade control
		M	automatic control
		N	direct level measuring device

(10 × 1) **[10]**

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QUESTION 3

Give ONE term for each of the following descriptions. Write only the word or term next to the question number (3.1–3.5) in the ANSWER BOOK.

3.1 A flowmeter that admits fluid into a chamber of known volume and then discharges it.

3.2 An electrical thermometer consisting of two dissimilar metal wires joined at one end.

3.3 It occurs when you make an incorrect reading, due to looking at the pointer on a scale at an angle, instead of with your eye perpendicular to the pointer on the scale.

3.4 When recording the measurements that have been read off an instrument on paper or typing it on a computer.

3.5 A mechanical pressure sensor consisting of two convoluted metal diaphragms, with their outer edges welded together to provide an empty chamber between them.

(5 × 1) **[5]**

TOTAL SECTION A: 20

SECTION B

QUESTION 4

4.1 List FOUR common process variables that are measured in a process plant. (4)

4.2 Name THREE standard of measurements as used in industrial instrumentation. (3)

4.3 Differentiate between *lower control limit* and *upper control limit*. (2 × 2) (4)

4.4 There are typical instrument errors that might be encountered when working with instruments.

Name any FOUR such errors. (4)
[15]

QUESTION 5

5.1 Give any FIVE components of the Bourdon tube pressure gauge. (5)

5.2 Draw a fully labelled diagram of pitot tube. (5)

5.3 Name FOUR advantages of a thermocouple. (4)

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5.4 Briefly describe the operating principles of the rotating paddle-type level gauge. (3)

5.5 A float is often used for level measurements. The level can be converted into angular or linear motion, but gives a somewhat nonlinear output.

5.5.1 Make a neat sketch of a float-type angular arm-type level gauge. (5)

5.5.2 Explain the working principle of the gauge in QUESTION 5.5.1. (3)
[25]

QUESTION 6

6.1 List THREE types of recorders and THREE different types of indicators. (3 × 2) (6)

6.2 Define the following elements:

6.2.1 Controller

6.2.2 Actuator

6.2.3 Signal transfer elements

(3 × 2) (6)

6.3 The standard on interconnections specifies the type of symbols to be used to represent the various types of connections in a processing plant.

Make neat, labelled sketches for the following interconnection.

6.3.1 Hydraulic line

6.3.2 Software line

(2 × 2) (4)

6.4 Brief explain the term *fail-safe system.* (4)
[20]

QUESTION 7

7.1 Name FOUR common types of boilers. (4)

7.2 Draw a fully labelled diagram of typical feed-forward control loop. (7)

7.3 Complete the following control loop terminology by indicating the meaning of the following acronyms or abbreviations:

7.3.1 SP

7.3.2 MV

7.3.3 CV

(3 × 1) (3)

7.4 List FOUR main functions of automatic control system. (4)

7.5 Define the term *impulse line connections.* (2)
[20]

TOTAL SECTION B: 80
GRAND TOTAL: 100

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