higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

INSTRUMENT TRADE THEORY N3

(11040463)

12 April 2021 (X-paper)
09:00–12:00

Drawing instruments may be used.

This question paper consists of 5 pages and 1 formula sheet.

136Q1A2112

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DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
INSTRUMENT TRADE THEORY N3
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. Start each section on a new page.
5. Use only blue or black ink.
6. Write neatly and legibly.

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QUESTION 1

1.1 Indicate whether the statements are TRUE or FALSE by writing 'True' or 'False' next to the question number (1.1.1–1.1.5) in the ANSWER BOOK.

1.1.1 The work principle of a strain gauge is that the electrical resistance of a conductor changes when a tension or a pressure is applied to it.

1.1.2 Bonded types are physically cemented to the structure of the strain that needs to be monitored.

1.1.3 An instrumentation system consists mainly of three sections which are used together for measuring and controlling.

1.1.4 A process is a physical substance that needs to be controlled.

1.1.5 A grid-type strain gauge consists of a thin wire shaped in a grid pattern bonded to a carrier sheet.

(5 × 1) (5)

1.2 List FIVE characteristics that influence the choice of wire for the manufacturing of a strain gauge is. (5)

1.3 If force or pressure is applied to certain crystals, such as quartz, Rochelle salt and barium titanate, the crystal generates an EMF proportional to the pressure or force applied to it.

1.3.1 Name the transducer described above. (1)

1.3.2 List FIVE advantages of this transducer. (5)

1.3.3 Name THREE disadvantages of this transducer. (3)

1.3.4 Make a neat, labelled sketch of this transducer. (6)

[25]

QUESTION 2

2.1 A thermopile is a temperature sensitive device.

2.1.1 Explain the construction and working principle of thermopiles. (3)

2.1.2 Make a neat, labelled sketch of a thermopile. (5)

2.2 Draw a basic characteristic graph of each of the thermistors:

2.2.1 PTC thermistor

2.2.2 NTC thermistor

(2 × 3) (6)

2.3 2.3.1 Name THREE advantages of using a pyrometer.

2.3.2 Name THREE disadvantages of using a pyrometer.

(2 × 3) (6)

2.4 Choose an item from COLUMN B that matches a description in COLUMN A. Write the letter (A–I) next to the question number (2.4.1–2.4.5) in the ANSWER BOOK.

COLUMN A		COLUMN B	
2.4.1	Hypothetical object capable of absorbing all the electromagnetic radiation falling on it	A	Seebeck effect
		B	Peltier effect
2.4.2	When a current flows along a copper wire with a temperature that varies from point to point, heat is liberated at any point when the current at that point flows in the direction of the flow of heat	C	thermocouple
		D	resistance temperature detector
		E	thermistor
2.4.3	Device that produces electricity by a difference in temperatures	F	thermal conductivity
		G	black body
2.4.4	A temperature sensitive device with a positive temperature coefficient	H	pyrometers
2.4.5	The rate at which heat is conducted through a material	I	Thomson's effect

(5× 1) (5)

[25]

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QUESTION 3

3.1 Complete the paragraph by writing the missing words next to the question number (3.1.1–3.1.4) in the ANSWER BOOK.

Pneumatic telemetering is used when a/an (3.1.1) … is not present. It is used where the use of (3.1.2) … is extremely dangerous. The transmitter, also known as the (3.1.3) …, changes movement from a measured variable into a single air pressure which is proportional to the (3.1.4) …

(4 × 1) (4)

3.2 Name FIVE types of electrical telemetering. (5)

3.3 Name FOUR disadvantages of a pneumatic system. (4)

3.4 Make a neat, labelled sketch of an on-off pneumatic telemetering system that is used to vary the pressure of the output signal, which is proportional to the measured variable. (6)

3.5 Explain how the pneumatic telemetering system in QUESTION 3.4 operates. (6)

[25]

QUESTION 4

4.1 Make a neat, freehand, labelled sketch of a control valve. (9)

4.2 Define the terms:

4.2.1 Load change

4.2.2 Measured variable

4.2.3 Control point

4.2.4 Automatic control

4.2.5 Offset

(5 × 1) (5)

4.3 In any form of process there are always a number of lags present. The type of lag depends on the type of process.

4.3.1 Explain the term lag as used in instrumentation. (2)

4.3.2 Name and explain THREE types of lags. (9)

[25]

TOTAL: 100

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FORMULA SHEET

(1) $R_s = \frac{V_{sc}}{I_s}$

(2) $R_z = \frac{V_{min}}{I_s} + R_{cj}$

(3) $R_{sh} = \frac{R_{sw} \times R_t}{R_{sw} - R_t}$

(4) $R_t = \frac{V_{max} - V_{min}}{I_s}$

(5) $R_u = \frac{V_{sc} - V_{max}}{I_s}$

(6) $I_s = \frac{1}{sensitivity}$

(7) $R_{cj} = R_0 + \Delta R$

(8) $\Delta R = \propto R_0 T$

(9) $\Delta R = \frac{\Delta V}{I_s}$

(10) $R_u = \frac{V_{std\ cell} - V_{max}}{I_s}$

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