higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

INSTRUMENT TRADE THEORY N3

(11040463)

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09:00–12:00

Drawing instruments and nonprogrammable calculators may be used.

This question paper consists of 6 pages.

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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. Use only a blue or black pen.
5. Write neatly and legibly.

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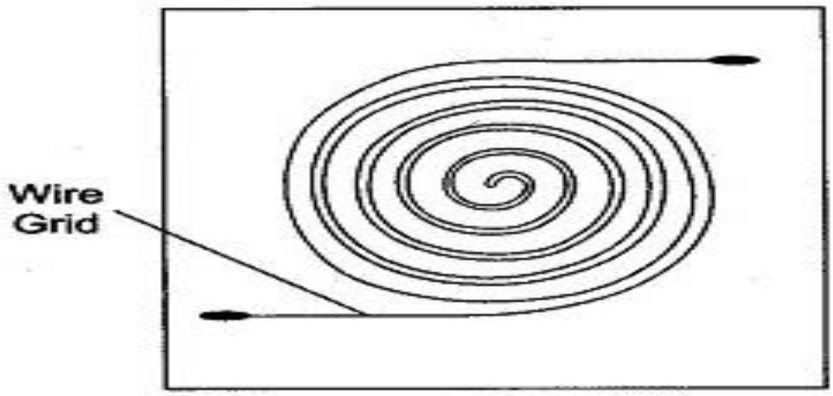
QUESTION 1

1.1 Study the following diagram and answer the questions.



1.1.1 What is the name of the strain gauge given in the figure above? (1)

1.1.2 What type of a strain gauge is depicted in the figure above? (1)

1.1.3 Give SEVEN advantages that the strain gauge above has compared to other strain gauges. (7)

1.2 Weighing a vessel and its contents calls for the installation of load cells.

1.2.1 What is a load cell? (1)

1.2.2 What is a load cell used for? (1)

1.2.3 Is a load cell a bonded or unbonded type of strain gauge? (1)

1.2.4 Make a neat, labelled diagram that shows how load cells are used to determine mass. (5)

1.3 Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'True' or 'False' next to the question number (1.3.1–1.3.6) in the ANSWER BOOK.

1.3.1 Reluctance is the property of an electric circuit that opposes a magnetic flux.

1.3.2 A capacitance pressure transducer is a diaphragm pressure sensor with a capacitor as the electrical element.

1.3.3 The input part in the instrumentation system receives the amount being measured and provides a signal proportional to the measured variable.

1.3.4 A strain gauge is a transducer that measures the deformation, or strain, of a rigid body as a result of the force applied to the body.

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1.3.5 An unbonded strain gauge consists of a fine wire laid out in the form of a grid on a substrate.

1.3.6 A piezoelectric pressure transducer requires an external power supply to operate.

(6 × 1) (6)

1.4 List TWO practical examples of physical quantities that are measured and controlled. (2)

[25]

QUESTION 2

2.1 Phenomena that govern the behavior of a thermocouple are the Seebeck effect, the Peltier effect, the Thompson effect, the law of intermediate temperatures, and the law of intermediate metals. Define the following:

2.1.1 Law of intermediate metals.

2.1.2 Law of intermediate temperatures.

(2 × 3) (6)

2.2 Make a neat, labelled sketch showing how you would connect two thermocouples to measure difference in temperatures. (6)

2.3 A blackbody is an ideal body that completely absorbs all radiant energy of any wavelength falling on it and reflects none of this energy from the surface.

2.3.1 Give TWO principles that are used for the construction of a radiation pyrometer. (2)

2.3.2 Make a diagram/sketch that shows blackbody radiation. (3)

2.4 Calculate the values of the resistance of a potentiometric recorder that has cold junction compensation.

The following data are given:

Recorder measuring range	200 °C to 800 °C
Standard cell voltage	1,019 V
Slide-wire resistance	20 Ω
Thermocouple outputs	8,1 mV at 200 °C and 41,3 mV at 800 °C
Cold junction resistor	5,77 Ω at 0 °C and 6,1 Ω at 35 °C
Both branch currents	2 mA
Ambient temperature	25 °C

(8)

[25]

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QUESTION 3

3.1 Electric transmission was developed to eliminate the problems and distance limitations of pneumatic transmission and to allow the use of a higher level of technology.

3.1.1 Name and explain the factors that affect the operation of electric transmission systems. (6)

3.1.2 Name TWO methods of how to compensate for supply variations in electric transmission systems. (2)

3.2 Make a neat, labelled diagram of the following electrical telemetering systems:

3.2.1 Voltage telemetering system

3.2.2 Current telemetering system

(2 × 6) (12)

3.3 Choose a description from COLUMN B that matches a word or item in COLUMN A. Write only the letter (A–G) next to the question number (3.3.1–3.3.5) in the ANSWER BOOK.

COLUMN A		COLUMN B	
3.3.1	Pneumatic telemetering	A	the transmitter is constructed from a cam that is rotated by a constant speed motor
3.3.2	Amplifies the pressure	B	device for measuring potential difference that is unknown
3.3.3	Direct acting relay valve	C	if a current is flowing in a circuit, the sum of all the voltages is equal to the applied voltage
3.3.4	Reverse acting relay valve	D	used when the electrical supply is not present
3.3.5	Impulse telemetering system	E	decrease in back pressure causes an increase in the output pressure
		F	increase in back pressure causes an increase in the output pressure
		G	function of a relay

(5 × 1) (5)

[25]

QUESTION 4

4.1 A pneumatic controller can be used to control a plant.

4.1.1 Sketch a labelled diagram of a proportional and integral position balance controller. (6)

4.1.2 Explain the operation of the control system in QUESTION 4.1.1. (4)

4.2 State FIVE forces that act on a pneumatic control valve. (5)

4.3 Briefly explain the meaning of each of the following control terms:

4.3.1 Automatic control (2)

4.3.2 Open-loop control (3)

4.4 In any form of process there are a number of lags present.

4.4.1 Give THREE types of lags. (3)

4.4.2 Explain the term *process.* (2)

[25]

TOTAL: 100

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