higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T910(**E**)(A5)T

NATIONAL CERTIFICATE

INSTRUMENT TRADE THEORY N3

(11040463)

5 April 2018 (X-Paper)

09:00–12:00

This question paper consists of 8 pages and 1 formula sheet.

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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. Number the answers according to the numbering system used in this question paper.

3. Read ALL the questions carefully.

4. Write neatly and legibly.

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SECTION A

QUESTION 1

1.1 Various options are given as possible answers to the following questions. Choose the answer and write only (A–D) next to the question number (1.1.1–1.1.5) in the ANSWER BOOK.

1.1.1 (n) ……is the time it takes for the integral action to repeat the proportional action if the measured deviation remain constant

A Derivative action time
B Time lag
C Integral action time
D Rate action

1.1.2 Which control action has a disadvantage of leaving an offset?

A Derivative action
B Proportional action
C Integral action
D On–off control action

1.1.3 Which the following pyrometer uses the principle of total radiation pyrometer?

A Disappearing filament pyrometer
B Wedge type disappearing filament pyrometer
C Mirror type pyrometer
D Morse type pyrometer

1.1.4 Which pyrometer can be calibrated by sighting it through a hole into a black body enclosure?

A Thermopile
B Optical pyrometer
C Black body condition
D Total radiation pyrometer

1.1.5 This is used to vary the pressure of the output signal which is proportional to the measured variable.

A Flapper and nozzle system with feedback bellows
B Flapper and nozzle system with feedback bellows and a relay valve
C Ratiometer system with diodes
D Flapper and nozzle system

(5 × 1) (5)

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1.2 Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'true' or 'false' next to the question number (1.2.1–1.2.5) in the ANSWER BOOK

1.2.1 The strain gauge load cells are the most common load cells used in the weighing industry.

1.2.2 Reluctance is the opposition to the generation of magnetic field.

1.2.3 A butterfly valve has only one characteristic.

1.2.4 Fundamental interval is the scaling between two fixed values/points.

1.2.5 Integral action is also known as rate action.

(5 × 1) (5)
[10]

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QUESTION 2

Choose a/an item/word/description from column B that matches a/an item /description in column A. Write only the letter (A–E) next to the question number (2.1–2.5) in the ANSWER BOOK.

COLUMN A		COLUMN B	
2.1	Type of a resistive pressure transducer	A	non-bounded strain gauge
2.2	Ɛ = ΔL/L	B	error
2.3	Transmission of measurements over long distances by electronic means for recording purposes	C	time lag
		D	position balance pneumatic system
2.4	The difference between the indicated value and the true value of the measured variable	E	quantities of warmth
		F	pyrometer
2.5	Telemetering system that uses the principle of balancing the an unknown force, which represents the input ,by a known force	G	bonded strain gauge
		H	telemetering
2.6	A device which measures the temperature of a hot object by means of the intensity of radiant energy exciting a phototube	I	potentiometer
		J	thermistor
		K	strain
2.7	It consists of a continuous fine wire wound between two sets of insulating pegs or frames, one stationary and the other free to move	L	strain gauge
		M	force balance pneumatic system
2.8	A temperature sensing device with a negative temperature coefficient		
2.9	A delay which occur from instantaneously complete response to an input signal		
2.10	A device for measuring a potential difference which is unknown by comparing it against a known potential difference		

(10 × 1) **[10]**

TOTAL SECTION A: 20

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QUESTION 3

3.1 A load cell is a transducer that is used to generate an electrical signal whose magnitude is directly proportional to the force being measured.

3.1.1 Is a load cell a bonded or unbounded strain gauge? (1)

3.1.2 Make a neat labeled diagram to show how load cells are used to determine mass. (5)

3.1.3 Give TWO applications of load cells. (2)

3.2 As technology advances more uses of rare-earth pressure transducer are being discovered by the industry.

3.2.1 Explain the operating principle of the rare earth transducer (2)

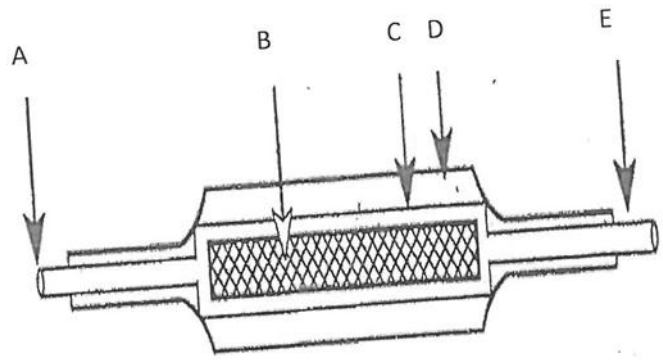
3.2.2 Make a drawing of a rare-earth and indicate clearly the transducers. (5)

3.2.3 Give five main advantages of the transducer mentioned in QUESTION 3.1 above (5)

[20]

QUESTION 4

4.1 Study the figure below and answer the questions.



4.1.1 Name the parts indicated in the figure above by writing only the answer next to the letter (A–E) in the ANSWER BOOK. (5)

4.1.2 Explain how the method shown in QUESTION 4.1.1 compensates for ambient temperature changes. (5)

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4.2 A resistance thermometer is connected to a Wheatstone bridge. Four wire compensation methods are used. Each lead wire to the thermometer has a resistance of 4 Ω. The circuit consists of three resistances of 16 Ω each.

4.2.1 Determine the total resistance of the branch of which the resistance stays constant. (2)

4.2.2 Prove that this circuit will compensate at any ambient temperature. (5)

4.2.3 Name THREE conditions that must be met so that the circuit mentioned in QUESTION 4.1, will compensate for any ambient temperature changes. (3) **[20]**

QUESTION 5

5.1 Make a neat labeled sketch of position telemetering system (6)

5.2 Explain the principle of operation of the telemetering system in Q 5.1 (10)

5.3 Give four disadvantages of flapper and nozzle system. (4)

[20]

QUESTION 6

6.1 Explain the following valve characteristics:

6.1.1 Linear characteristics

6.1.2 Equal percentage characteristics

6.1.3 Quick opening

(3 × 2) (6)

6.2 Make a neat, labelled graphical representation of the valve characteristics mentioned in QUESTION 6.1. (5)

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6.3 Sketch a motion balance type of valve positioner that incorporates the following:

- A receiving bellows
- A feedback spring
- A relay
- A flapper and nozzle
- A valve motor (5)

6.4 Name FOUR forces that act on a pneumatic control valve. (4)
[20]

TOTAL SECTION B: 80
GRAND TOTAL: 100

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INSTRUMENT TRADE THEORY N3

FORMULA SHEET

$P_G = P_{abs} - Pa$

$P_1 - P_2 = h\rho g$

$P_1 - P_2 = d\rho g \left(\frac{A1}{A2} + 1\right)$ or $P_1 - P_2 = d\rho g \left(\frac{A2}{A1} + 1\right)$

$P = \frac{Mg}{A}$

$\frac{Q1}{Q2} = \frac{k\sqrt{h1}}{k\sqrt{h2}}$

Dry calibration = $\frac{P1-P2}{\rho g}$

Wet calibration = $\frac{P1-P2}{(\rho 2 - \rho 1)g}$

W.C. = $\left(\frac{P1-P2}{(\rho 2 - \rho 1)}\right)$ X D.C

D.C. = $\left(\frac{P1-P2}{\rho 2}\right)$ X W.C.

$H = \frac{\Delta P}{\rho g}$

$H = h\frac{\rho 2}{\rho 1}$

$t^o = 9/5\ t + 32^o F$

$t^o C = (t + 273{,}15)$ kelvin

$t^o F = 5/9\ (t - 32)^o C$

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