higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

INSTRUMENT TRADE THEORY N3

2 August 2021

This marking guideline consists of 6 pages.

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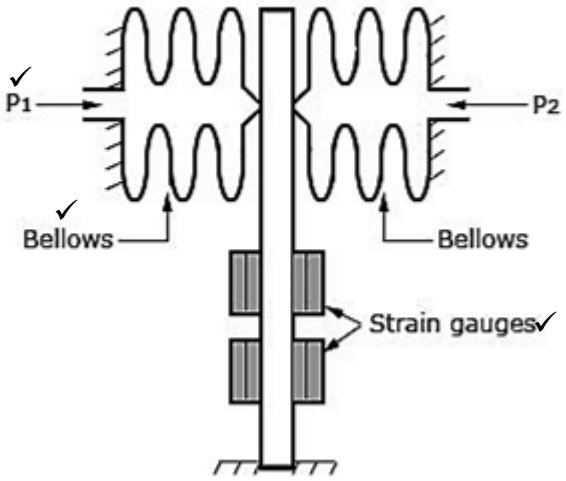
QUESTION 1

1.1
- Inductance
- Reluctance (2)

1.2
- Inductance type transducers operate on the principle of a change in inductance in an alternating-current circuit.
- Reluctance type transducers operate on the principle of changing the air gap between the magnet and the core (reluctance). (2 + 2) (4)

1.3

Pressure Measurement With Strain Gauge on Bellows



- Strain gauges is cemented to a fixed cantilever ✓
- Differential pressure changes tension on the cantilever ✓
- Strain gages measures this tension in cantilever in effect measuring the differential pressure. ✓

(6)

1.4 1.4.1 Spiral-type bonded strain gauge or foil type strain gauge (1)

1.4.2 The wire is replaced with a thin foil✓ to obtain a bigger contact area.✓ (2)

1.4.3
- It follows the surface to which it is cemented very well.
- It has a high gauge factor.
- It is made waterproof easily.
- Special patterns are easily produced.
- It has relatively small creep and hysteresis effects.
- Because of the big contact area foil gauges dissipate heat easily.
- It can be prepared within a few minutes with the proper cement and equipment. (Any 5 × 1) (5)

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1.5 The electrical resistance will change when tension or pressure is applied to it.✓✓ The change in length (as well as the change in cross-sectional area) of the wire will be proportional to the applied stress and the electrical resistance will be related to the length and cross-sectional area as shown in the equation.✓✓

Formula: $R = \frac{p \times l}{A}$✓ (5)

[25]

QUESTION 2

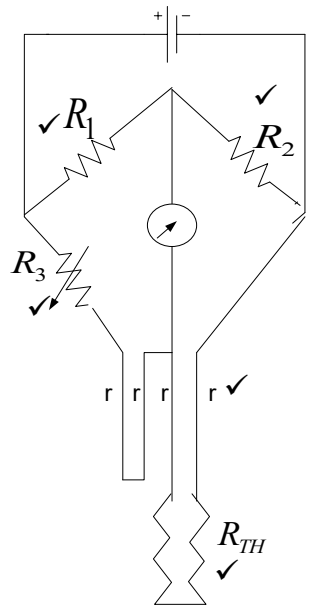
2.1 2.1.1 True
2.1.2 True
2.1.3 True
2.1.4 True
2.1.5 False

(5 × 1) (5)

2.2 2.2.1
- Thermistors
- Thermocouples
- Resistance temperature detectors (3)

2.2.2
$$R_T = Ae^{\frac{B}{T}}$$
$$100 \times 10^3 = Ae^{\frac{3\,000}{300}}$$
$$\Longrightarrow A = 4{,}54$$
$$R_{900} = 4{,}54e^{\frac{3\,000}{900}}$$
$$= 127{,}26\ \Omega$$ (4)

2.3 2.3.1



(2 marks for correct drawing) (5)

2.3.2 $Rt = R1 + R2$✓
$= 15 + 15$✓
$= 30\ \Omega$✓ (3)

2.3.3 $R1/R3 + L1 + L2 = R2/Rt + L3 + L4$✓
$15/15 + 4 + 4 = 15/Rt + 4 + 4$
$15(Rt + 8)/15 = 15(15 + 8)/15$✓
$Rt + 8 = 15 + 8$✓
$Rt = 15 + 8 - 8$
$Rt = 15\ \Omega = R3$✓✓ (5)
[25]

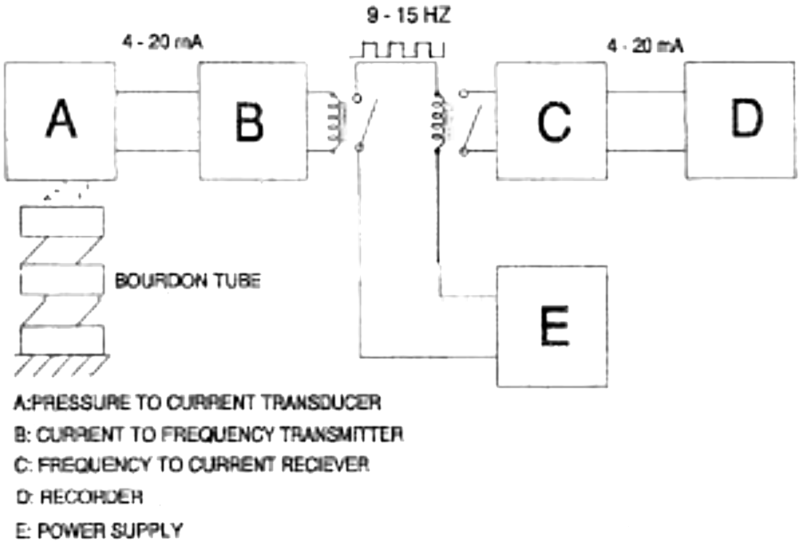
QUESTION 3

3.1 3.1.1 G
3.1.2 F
3.1.3 B
3.1.4 A
3.1.5 D
(5 × 1) (5)

3.2 3.2.1 Telemetry is an automated communication process by which measurements and other data are collected at remote locations and transmitted to receive equipment for monitoring. (2)

3.2.2
- Remote pressure reading
- Fuel-oil monitoring
- Water-level monitoring
- Remote speed reading
- Remote meter reading (2)

3.2.3



(3 for the correct drawing + 5 for labels) (8)

3.2.4
- No time lag
- Not sensitive to vibration
- Linear output
- Unlimited range
- Electrical signals over many kilometres
- No pressure drop (Any 5 × 1) (5)

3.2.5
- Supply voltage variations
- Load resistor
- Lead wires (3)

[25]

QUESTION 4

4.1 4.1.1 Control system in which the output has no influence or effect on the control action of the input signal

4.1.2 Control system with feedback from the measuring element back to the correcting element

4.1.3 Difference between the measured value and set point

4.1.4 Movable part of a valve body assembly that provides a variable restriction of flow

4.1.5 Signal that deviates from the desired value

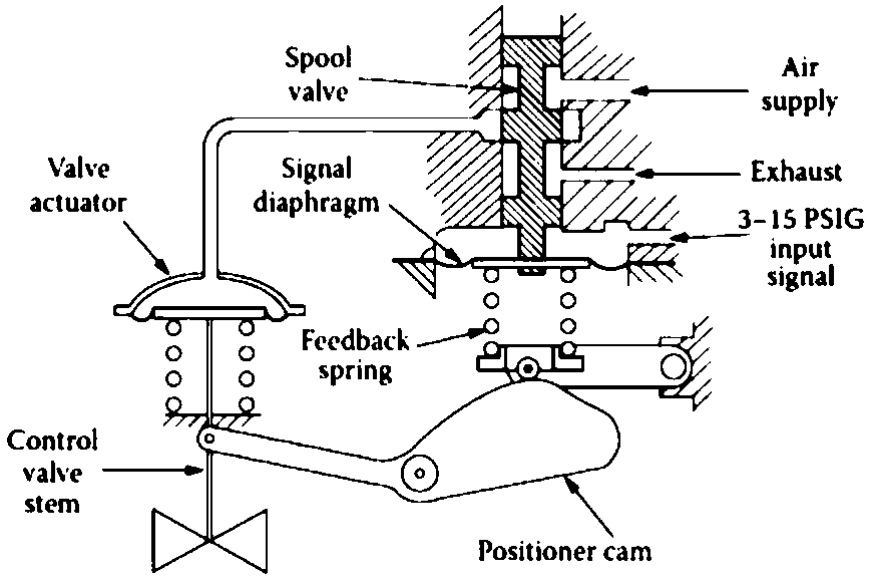
(5 × 1) (5)

4.2 4.2.1 A positioner moves the actuator stem in accordance with the value of the input signal.✓✓ It is operated from a separate air supply through a relay to drive the stem to the desired position.✓ (3)

4.2.2 An increase in air pressure on the diaphragm will cause the valve to open and allow an increase of flow through the valve. (2)

4.2.3
- The high gain helps to overcome stem friction.
- The valve stroke is closely matched to the input signal.
- The input signal is dead-ended in a small chamber thereby reducing time lag.
- Split-ranging is easily obtained due to the amplification.
- The positioner output is independent of the input signal permitting greater thrust. (5)

4.2.4



(3 for correct drawing) (10)
[25]

TOTAL: 100