



**POSTAL
BOOK PACKAGE**

2024

CONTENTS

**INSTRUMENTATION
ENGINEERING**

Objective Practice Sets

Sensors & Industrial Instrumentation

1. Introduction to Transducers 2 - 4
2. Resistive Transducers 5 - 11
3. Capacitive Transducers 12 - 18
4. Inductive Transducers 19 - 22
5. Piezo-Electric Transducers 23 - 28
6. Measurement of Flow & Level 29 - 37
7. Measurement of Pressure 38 - 43
8. Measurement of Temperature 44 - 52
9. Measurement of Force & Torque 53 - 56
10. Measurement of Velocity, Acceleration,
Vibration & Shock 57 - 61
11. Measurement of Viscosity, pH Value
and Conductivity 62 - 64
12. 4-20 mA Two-wire Transmitter 65 - 65

Introduction to Transducers

MCQ and NAT Questions

Q.1 Some of the functional building blocks of a measurement system are:

Primary Sensing Element (PSE)

Variable Conversion Element (VCE), or Transducer
Data Transmission Element (DTE)

Variable Manipulation Element (VME)

Data Presentation Element (DPE)

The correct sequential connection of the functional building blocks for an electronic pressure gauge will be

- (a) PSE, VME, VCE, DPE, DTE
- (b) PSE, VCE, VME, DTE, DPE
- (c) DTE, DPE, VCE, PSE, VME
- (d) PSE, VCE, DTE, DPE, VME

Q.2 Which one of the following transducers is classified as an active transducer?

- (a) Metallic strain gauge
- (b) Capacitive microphone
- (c) LVDT
- (d) Piezoelectric transducer

Q.3 Inverse transducers

- (a) converts electrical energy to any other form of energy
- (b) converts electrical energy to light energy
- (c) converts mechanical displacement into electrical signal
- (d) converts electrical energy to mechanical form

Q.4 Match **List-I (Transducers)** with **List-II (Measured Quantity)** and select the correct answer using the codes given below the lists:

List-I	List-II
A. Capacitive transducer	1. Pressure
B. Thermocouple	2. Torque
C. Load cell	3. Displacement
D. Diaphragm	4. Temperature

Codes:

	A	B	C	D
(a)	2	4	3	1
(b)	3	1	2	4
(c)	2	1	3	4
(d)	3	4	2	1

Q.5 Very small displacements are effectively measured using

- (a) LVDT
- (b) Strain gauge
- (c) Thermistor
- (d) Tachogenerator

Q.6 Which one of the following transducers requires power supply for its operation?

- (a) Thermocouple
- (b) Photovoltaic cell
- (c) Piezoelectric crystal
- (d) Thermistor

Q.7 Which one of the following transducers is the most suitable for the measurement of linear displacement?

- (a) Strain gauge
- (b) LVDT
- (c) Piezoelectric crystal
- (d) Microphone

Q.8 Match **List-I (Transducers)** with **List-II (Types of transducer)** and select the correct answer using the code given below the lists:

List-I	List-II
A. LVDT	1. Resistive
B. Strain Gauge	2. Inductive
C. Dielectric Gauge	3. Capacitive
D. Thermocouple	4. Self generating

Codes:

	A	B	C	D
(a)	2	3	1	4
(b)	4	3	1	2
(c)	2	1	3	4
(d)	4	1	3	2

- Q.9** Dynamics of a thermocouple can be modeled as,
a
- (a) zero order equation
 - (b) first order equation
 - (c) second order equation
 - (d) none of the above

- Q.10** The lower limit of useful working range of a transducer is determined by
- (a) minimum useful input level
 - (b) cross sensitivity
 - (c) transducer error and noise
 - (d) dynamic response of the transducer

- Q.11** Match the contents of **List-I (Transducer)** with the contents of **List-II (Application for which they are used)**:

List-I	List-II
A. Dielectric Gauge	1. Temperature
B. Reluctance pick-up	2. Thickness
C. Pirani Gauge	3. Gas Flow
D. RTD	4. Position

Codes:

- | A | B | C | D |
|-------|---|---|---|
| (a) 2 | 4 | 3 | 1 |
| (b) 3 | 2 | 4 | 1 |
| (c) 2 | 3 | 4 | 1 |
| (d) 1 | 4 | 3 | 2 |

- Q.12** The output voltage of a transducer is connected to an amplifier. The amplifier has an input resistance of 490 k Ω . The output resistance of the transducer if the error in recording of the transducer output is 1% is
- (a) 10 k Ω
 - (b) 9.6 k Ω
 - (c) 49 k Ω
 - (d) 4.9 k Ω

- Q.13** In a seismic pickup, damping factor ξ is to be doubled without changing natural frequency ω_n . This can be achieved by
- (a) Double damping
 - (b) Quadruple seismic mass
 - (c) Quadruple spring constant
 - (d) Double seismic mass and spring constant

Multiple Select Questions (MSQs)

- Q.14** Signal conditioning of transmitters signal is important for faithful production of an output. Which of the following is/are performed in signal conditioning circuit :
- (a) Amplification
 - (b) Calibration & Zeroing
 - (c) Filtering
 - (d) Controlling

- Q.15** A Hall effect transducer is used to measure
- (a) Power
 - (b) Current
 - (c) Displacement
 - (d) Minority carriers in a semiconductors

- Q.16** For a seismic transducer natural frequency has to be increased. This could be achieved by
- (a) Increasing damping
 - (b) Increasing spring constant
 - (c) Increasing seismic mass
 - (d) Decreasing damping

- Q.17** Which of the following devices are non-contact type level transmitters :
- (a) Ultrasonic level meters
 - (b) Vibrating tuning fork
 - (c) Guided wave radar
 - (d) Nuclear level meters

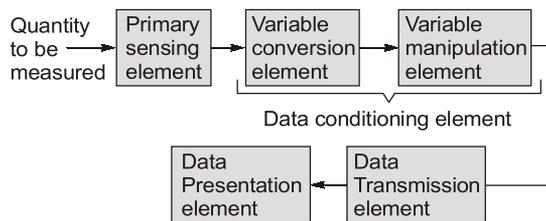
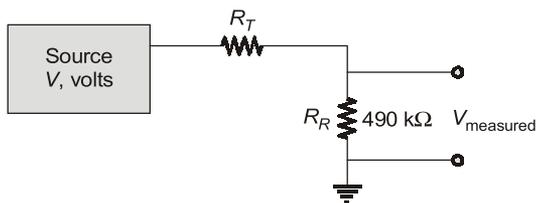


Answers Introduction to Transducers

1. (b) 2. (d) 3. (a) 4. (d) 5. (a) 6. (d) 7. (b)
 8. (c) 9. (b) 10. (c) 11. (a) 12. (d) 13. (a) 14. (a, b, c)
 15. (a, b, c, d) 16. (b, c) 17. (a, d)

Explanations Introduction to Transducers**1. (b)**

Functional elements of a measurement system are shown below:

**12. (d)**

For no error – R_R (Recorder resistance) should be very high and R_T (Transducer resistance) should be very low

$$V - \frac{490}{490 + R_T} \times V$$

$$\frac{\quad}{V} \times 100 = 1$$

$$\frac{V(490 + R_T) - 490 V}{(490 + R_T)V} \times 100 = 1$$

$$(490 + R_T - 490) 100 = 490 + R_T$$

$$100 R_T = 490 + R_T$$

$$99 R_T = 490$$

$$R_T = \frac{490}{99} \text{ k}\Omega = 4.9 \text{ k}\Omega$$

13. (a)

We have

$$\xi = \frac{B}{2} \sqrt{KM}$$

and

$$\omega_n = \sqrt{KM}$$

So, since ω_n is constant, \sqrt{KM} is constant.

So, to double damping factor ξ we need to double damping B .

16. (b, c)

$$\omega_n = \sqrt{KM}$$

So,

$$\omega_n \propto \sqrt{K}$$

and

$$\omega_n \propto \sqrt{M}$$

So, to increase ω_n , we need to increase either seismic mass as spring.

17. (a, d)

- (i) Guided wave radar has sensor tube which touches the liquid.
- (ii) Vibrating tuning fork changes its natural frequency of oscillation when liquid comes in contact.

■■■■