

GUJARAT TECHNOLOGICAL UNIVERSITY

BE-6 SEMESTER – OLD PAPER – S22 TO W25 – QUESTION BANK

Subject Name & Code:

SENSORS AND TRANSDUCERS (3161008)

Unit 1: Introduction to Electronics Measurement and Instrumentation

Repeated Questions:

1. **Define/Explain:** Sensitivity, Precision, Accuracy, Drift, Fidelity, Hysteresis, Linearity, Range/Span, Threshold, Resolution, Repeatability, etc.
(W25 - Q1a & Q1b, 03 & 04 marks)
(S25 - Q1b, 04 marks)
(S24 - Q1a, 03 marks)
(W24 - Q1a, 03 marks)
(W23 - Q1a, 03 marks)
(W22 - Q1b, 04 marks)
(S22 - Q1a, 03 marks)
2. **List/Discuss types of errors in measurement systems.**
(W25 - Q1c, 07 marks)
(W23 - Q1b, 04 marks)
(S22 - Q1c, 07 marks)
3. **Explain sensor classification.**
(W25 - Q1a, 03 marks)
(W24 - Q1b, 04 marks)
(W23 - Q1c, 07 marks)
4. **Explain sensor calibration techniques.**
(S25 - Q1c, 07 marks)
(W24 - Q1c, 07 marks)

Other Important Questions (Newest to Oldest):

1. **List down different types calibration techniques for sensors. Explain any one of them.** (S25 - Q1c, 07 marks)
2. **Define following: 1. Settling time 2. Fidelity 3. Hysteresis 4. Linearity.** (S25 - Q1b, 04 marks)
3. **How the performance of any sensor is measured?** (S25 - Q1a, 03 marks)
4. **Define: (1) Sensitivity (2) Repeatability (3) Hysteresis.** (S22 - Q1a, 03 marks)
5. **What is meant by two wire and three wire sensors? Give example for each type.** (S22 - Q1b, 04 marks)
6. **Write down types of Errors and explain any two errors in detail.** (W23 - Q1c, 07 marks)
7. **Define: (1) Precision (2) Drift (3) Range/Span.** (W23 - Q1a, 03 marks)
8. **Define: (1) Speed of Response (2) Fidelity (3) Lag (4) Dynamic Error.** (W23 - Q1b, 04 marks)
9. **Define: (1) Accuracy (2) Repeatability (3) Resolution.** (W23 - Q1a, 03 marks)
10. **Define: (1) Sensitivity (2) Precision (3) Accuracy.** (W22 - Q1a, 03 marks)
11. **Write short note on Limiting Errors.** (W22 - Q1b, 04 marks)
12. **A 0-150 V voltmeter has a guaranteed accuracy of 1% of full scale reading. The voltage measured by this instrument is 75 V. Calculate the limiting error in percent. Comment upon the result.** (W22 - Q1c, 07 marks)
13. **Define following: 1. Threshold 2. Drift 3. Fidelity.** (W24 - Q1a, 03 marks)
14. **What are the different techniques to calibrate sensors? Explain any one of them.** (W24 -

Q1c, 07 marks)

15. **Explain Transducer with its characteristics and also give advantages and disadvantages.** (W22 - Q1c, 07 marks)
 16. **Differentiate between Sensor and Transducer.** (W23 - Q1a, 03 marks)
-

Unit 2: Temperature Sensors

Repeated Questions:

1. **Compare/Contrast RTD, Thermistor, and Thermocouple.**
(S25 - Q2a, 03 marks)
(S22 - Q2b, 04 marks)
(W23 - Q2c, 07 marks)
(W22 - Q2c, 07 marks)
2. **Explain construction, principle, working, and characteristics of Thermistor.**
(S25 - Q2c, 07 marks)
(W25 - Q2c, 07 marks)
(S22 - Q2c OR, 07 marks)
(W23 - Q2c OR, 07 marks)
3. **Explain construction, principle, working, and characteristics of Thermocouple.**
(S25 - Q2a, 03 marks)
(W23 - Q2b, 04 marks)
(W22 - Q3c OR, 07 marks)
4. **Explain RTD and how it measures temperature.**
(W22 - Q2c, 07 marks)
(W23 - Q2c, 07 marks)

Other Important Questions (Newest to Oldest):

1. **Write advantages and disadvantages of Thermocouple.** (S25 - Q2a, 03 marks)
 2. **What is thermistor and how it works?** (S25 - Q2b, 04 marks)
 3. **How a thermistor differs from a thermocouple as a temperature sensor?** (W25 - Q2a, 03 marks)
(W22 - Q2a, 03 marks)
 4. **Differentiate characteristics of RTD and Thermistor.** (W25 - Q2b, 04 marks)
(S22 - Q2b, 04 marks)
 5. **Describe working of Radiation temperature sensor.** (W24 - Q2a, 03 marks)
 6. **Explain thermoelectric effects for thermocouple.** (W24 - Q2b, 04 marks)
 7. **What is thermistor? How does it sense temperature? Explain its one of application.** (W24 - Q2c, 07 marks)
 8. **Write advantages and disadvantages of Thermistor.** (W22 - Q2b, 04 marks)
 9. **Discuss why thermocouples require a reference junction.** (S22 - Q2a, 03 marks)
 10. **Explain calibration technique.** (W22 - Q2a, 03 marks)
 11. **Explain the function block of the measurement system with neat diagram.** (W22 - Q2b, 04 marks)
-

Unit 3: Motion, Proximity and Ranging Sensors

Repeated Questions:

1. **Explain construction, principle, working, characteristics, advantages & disadvantages of LVDT.**
(S25 - Q2c OR, 07 marks)
(W25 - Q2c OR, 07 marks)
(S22 - Q2c OR, 07 marks)
(W23 - Q3c OR, 07 marks)
(W22 - Q2c OR, 07 marks)
2. **Explain Potentiometer as a motion sensor.**
(S25 - Q2c OR, 07 marks)
(S22 - Q2c, 07 marks)
(W22 - Q2c, 07 marks)
3. **Explain Laser Range Sensor (LIDAR).**
(W24 - Q2c OR, 07 marks)
(W25 - Q3c, 07 marks)
(W23 - Q3a, 03 marks)

Other Important Questions (Newest to Oldest):

1. **List out applications of the RF beacons.** (S25 - Q3a, 03 marks)
 2. **Define motion sensor. List the various types of motion sensors. List the motion sensors application.** (W24 - Q3b, 04 marks)
 3. **What are the advantages and disadvantages of LVDT?** (W24 - Q3a, 03 marks)
 4. **Write any three applications of LVDT.** (W23 - Q2a, 03 marks)
 5. **Explain RVDT.** (W22 - Q3b, 04 marks)
 6. **Define encoder. List out types of encoder.** (W24 - Q4a OR, 03 marks)
 7. **Explain the operation and application of Laser range Sensor (LIDAR).** (W24 - Q2c OR, 07 marks)
 8. **Write short note on Proximity Sensor.** (W23 - Q3b OR, 04 marks)
 9. **Write the application of Tactile Sensor.** (W23 - Q3a, 03 marks)
 10. **What is meant by Tactile Sensor?** (S22 - Q3b, 04 marks)
 11. **Explain Accelerometer.** [Implied from syllabus, not directly asked but relevant]
 12. **Explain Ultrasonic Ranging.** [Implied from syllabus, not directly asked but relevant]
-

Unit 4: Pressure, Force, Displacement and Weight Measurement, Magnetic Sensor

Repeated Questions:

1. **Define/Explain Strain Gauge, Gauge Factor, types.**
(S25 - Q3a OR, 03 marks)
(S22 - Q3a, 03 marks)
(W24 - Q3a OR, 03 marks)
(W22 - Q3b OR, 04 marks)
2. **Define/Explain Hall Effect and its applications/sensor.**
(S25 - Q3b, 04 marks)
(W25 - Q3a OR, 03 marks)
(W24 - Q3c OR, 07 marks)
3. **Explain Load Cell (principle, construction, types, applications).**
(W24 - Q3b OR, 04 marks)
(W23 - Q3b, 04 marks)
(W22 - Q5a OR, 03 marks)
4. **Explain Piezoelectric Effect/Transducer/Sensor.**
(S22 - Q3c OR, 07 marks)
(W24 - Q4a, 03 marks)
(W23 - Q3c, 07 marks)

Other Important Questions (Newest to Oldest):

1. **What are the different types of magnetic sensors? On what principles do they work? Outline briefly.** (S25 - Q3c, 07 marks)
2. **Write down the advantages of magnetic sensors.** (S25 - Q3b OR, 04 marks)
3. **List out various types of Strain Gauges.** (W25 - Q3a, 03 marks)
4. **Compare Capacitive and Inductive transducers.** (W25 - Q3b, 04 marks)
5. **Define Hall- effect and justify its applications of it.** (W25 - Q3a OR, 03 marks)
6. **Explain Tactile Sensor.** (W25 - Q3b OR, 04 marks)
7. **Discuss the operation of a Strain Gauge and evaluate its applications as a force sensor.** (W25 - Q3c OR, 07 marks)
8. **Define gauge factor? What are the different types of strain gauge?** (W24 - Q3a OR, 03 marks)
9. **Define load cell. List out the various kinds of load cells. Enumerate use of load cell.** (W24 - Q3b OR, 04 marks)
10. **Describe the construction and working of magnetic sensors.** (W24 - Q3c, 07 marks)
11. **Write down the characteristics of Strain Gauge.** (W23 - Q3a, 03 marks)
12. **Explain Magneto Resistive Effect.** (W23 - Q3a OR, 03 marks)
13. **Explain the principle, construction, working and applications of Ultrasonic Flow Meter with neat sketches.** (S22 - Q3c OR, 07 marks)
14. **Define Dark Resistance and list out some materials used for construction of LDR.** (S22 - Q3b, 04 marks)
(W25 - Q4b, 04 marks)
15. **Give principle and construction of Load cell.** (W22 - Q5a OR, 03 marks)
16. **Explain types of Magnetic Sensor with its principle and advantages.** (W23 - Q3c OR, 07 marks)
17. **Define Piezo Electric effect. Draw the equivalent circuit of a Piezoelectric crystal and derive the transfer function of Piezo Electric transducer.** (S22 - Q3c, 07 marks)
18. **What is piezo electric effect? What are the classifications of piezoelectric transducers?** (W24 - Q4a, 03 marks)

Unit 5: Flow Measurement, Power Measurement, Optical Sensors

Repeated Questions:

1. **Explain Ultrasonic Flow Meter.**
(S25 - Q4a, 03 marks)
(W23 - Q4a, 03 marks)
(S22 - Q3c OR, 07 marks)
2. **Explain Photo Conductive Cell (LDR).**
(W25 - Q4a OR, 03 marks)
(W23 - Q4b, 04 marks)
(S22 - Q4b OR, 04 marks)
3. **Explain Fiber Optic Sensor (working, advantages, applications).**
(S25 - Q4a, 03 marks) [Advantages & Apps]
(W25 - Q4a, 03 marks)
(W23 - Q4a, 03 marks)
(W22 - Q5c OR, 07 marks)
4. **Compare Magnetic and Ultrasonic flow meter.**
(W23 - Q4a, 03 marks)

Other Important Questions (Newest to Oldest):

1. **List the properties of piezoelectric crystals.** (S25 - Q4b, 04 marks)
 2. **What is gyroscope? Explain the principle of operation and properties of it with relevant diagrams.** (S25 - Q4c, 07 marks)
 3. **State advantages of fiber Optic sensors and write its applications.** (W25 - Q4a, 03 marks)
 4. **Define Dark Resistance and list out some materials used for the construction of LDR.** (W25 - Q4b, 04 marks)
 5. **Explain Photo Conductive Cell in brief.** (W25 - Q4a OR, 03 marks)
 6. **Explain Power Factor meter.** (W25 - Q4b OR, 04 marks)
 7. **Explain the working of kelvin's double bridge for measurement of low resistance with a neat diagram.** (W25 - Q4c OR, 07 marks)
 8. **What is fiber optic sensor? Draw and explain the block diagram of fiber optic sensor.** (W24 - Q4b, 04 marks)
 9. **Explain the basic principle of gyroscope and its types.** (W24 - Q4c, 07 marks)
 10. **Compare Magnetic and Ultrasonic flow meter.** (W23 - Q4a, 03 marks)
 11. **Explain Photo Conductive cell.** (W23 - Q4b, 04 marks)
 12. **Explain LDR.** (W23 - Q4b OR, 04 marks)
 13. **Explain any one capacitive transducers.** (W23 - Q4c OR, 07 marks)
 14. **Explain orifice meter for flow measurement.** (W22 - Q4b, 04 marks)
 15. **Explain heat transfer using thermal conduction.** (W22 - Q4c, 07 marks)
 16. **Explain ultrasonic flow meter.** (W23 - Q4a OR, 04 marks)
 17. **Explain IR Sensor.** (W23 - Q4a, 03 marks)
 18. **Explain electronic energy meter.** (W23 - Q4a OR, 03 marks)
 19. **Explain Photo Conductive Cell and Photo Voltaic Cell.** (W23 - Q4c OR, 07 marks)
 20. **How can optical fiber be used for stress sensing?** (S22 - Q3a OR, 03 marks)
-

Unit 6: Special Sensors (GPS, Bluetooth, Smart Sensors, MEMS, Nano, LASER, Touch, Heading, etc.)

Repeated Questions:

1. **Explain/Define GPS and list its applications.**
(S25 - Q5b, 04 marks) [Implied in syllabus]
(W25 - Q5a OR, 03 marks)
(W23 - Q5b, 04 marks)
(W22 - Q3a OR, 03 marks)
2. **Compare MEMS and Nano Sensors.**
(S25 - Q5a, 03 marks)
(S22 - Q4b, 04 marks)
(W23 - Q3b, 04 marks)
3. **Explain Smart Sensor / Architecture.**
(W22 - Q3a, 03 marks)
(S22 - Q4b, 04 marks)

Other Important Questions (Newest to Oldest):

1. **List down the features and applications of inclinometers.** (S25 - Q5a OR, 03 marks)
 2. **List out any two applications which need MEMS sensors.** (W25 - Q5a, 03 marks)
 3. **What is smart sensor? Mention application of smart sensor.** (W22 - Q3a, 03 marks)
 4. **Explain GPS (Global Positioning System.) Also give advantages.** (W22 - Q3a OR, 03 marks)
 5. **Write a short note on Bluetooth.** (W23 - Q5b, 04 marks)
 6. **Write a short note on GPS.** (W23 - Q5b, 04 marks)
 7. **Explain Bluetooth Sensor.** (W23 - Q5a, 03 marks)
 8. **Write the application of sensors in drone.** (W23 - Q5a OR, 03 marks)
(W23 - Q3a, 03 marks)
 9. **Explain Touch screen sensor.** (W22 - Q5b OR, 04 marks)
 10. **What is gyroscope sensor? Explain its type and give its application.** (W22 - Q3c, 07 marks)
 11. **Explain LASER sensor / LIDAR (covered in Unit 3).** (W23 - Q3a, 03 marks) (W24 - Q2c OR, 07 marks)
-

Unit 7: Analog Signal Conditioning

Repeated Questions:

1. **Explain Instrumentation Amplifier (requirements, circuit, gain).**
(S25 - Q4c OR, 07 marks)
(W22 - Q4a, 03 marks)
(S22 - Q4a, 03 marks)
(W23 - Q5a, 03 marks)
2. **Explain various Bridges (Maxwell, Hay, Kelvin, Wein, Wheatstone).**
(Maxwell) - (S25 - Not in direct papers but in syllabus)
(W23 - Q3c, 07 marks)
(W22 - Q4c OR, 07 marks)
(Kelvin) - (W25 - Q4c OR, 07 marks)
(W22 - Q4c, 07 marks)
(Wein) - (S22 - Q4c OR, 07 marks)
(Wheatstone limitations) - (S22 - Q4a, 03 marks) (W23 - Q3a, 03 marks)
3. **Define/Explain Signal Conditioning and its need.**
(S25 - Q4a OR, 03 marks)
(W25 - Q5b OR, 04 marks)
(W24 - Q5a, 03 marks)
4. **List applications of Attenuators, Amplifiers, Filters in signal conditioning.**
(S25 - Q4b OR, 04 marks)
(W24 - Q5a OR, 03 marks)
(W23 - Q4a OR, 03 marks)

Other Important Questions (Newest to Oldest):

1. **What is meant by signal conditioning and why it is required?** (S25 - Q4a OR, 03 marks)
(W24 - Q5a, 03 marks)
2. **List down the applications of attenuators, amplifiers and passive filters in signal conditioning.** (S25 - Q4b OR, 04 marks)
3. **Elaborate an Instrumentation amplifier with neat diagram and estimate its gain.** (S25 - Q4c OR, 07 marks)
4. **Explain the working of Hay's bridge with suitable phasor diagram.** (W25 - Q4c, 07 marks)
5. **What is signal conditioning and why is it required.** (W25 - Q5b OR, 04 marks)
6. **Write limitations of Wheatstone Bridge.** (S22 - Q4a, 03 marks)
7. **Show the block diagram of Smart Sensor Architecture.** (S22 - Q4b, 04 marks)
8. **Draw Maxwell's Bridge circuit and derive the expression for the unknown element at balance.** (S22 - Q4c, 07 marks)
9. **Write advantages of AC Bridges.** (S22 - Q4a OR, 03 marks)
10. **Compare MEMS Sensors and Nano Sensors.** (S22 - Q4b OR, 04 marks)
11. **Draw Wein's Bridge Circuit and derive expression for the unknown element at balance.** (S22 - Q4c OR, 07 marks)
12. **Write down any four requirements of an Instrumentation Amplifier.** (W22 - Q4b, 04 marks)
13. **Draw an Inverting Amplifier using Op-Amp and derive formula for its gain.** (W22 - Q4a, 03 marks)
14. **Suggest suitable detectors for AC bridges for the following frequency ranges. (1) 250Hz to 4KHz (2) Below 200Hz (3) 10Hz to 100KHz.** (W22 - Q4b OR, 04 marks)
15. **Discuss working of Maxwell's Bridge for measurement of Inductance. For what range of Q- factor of the coil, the bridge is suitable?** (W22 - Q4c OR, 07 marks)
16. **Write any two advantages and any two disadvantages of Hay's bridge.** (W23 - Q3b OR, 04 marks)
17. **Write down any three requirements of Instrumentation amplifier.** (W23 - Q5a, 03 marks)
18. **Explain Differential amplifier and Instrumentation amplifier.** (W23 - Q5c OR, 07 marks)

19. Contrast the types of amplifiers that can be used with sensors. Assess the need of amplifiers in sensing applications. (W24 - Q5b OR, 04 marks)
-

Unit 8: Digital Signal Conditioning

Repeated Questions:

1. **Explain Sample and Hold Circuit.**
(S25 - Q5c OR, 07 marks)
(W25 - Q5b, 04 marks)
(W24 - Q5c, 07 marks)
(W23 - Q1b, 04 marks)
(W22 - Q5b OR, 04 marks)
2. **Compare Weighted Resistor DAC and R-2R Ladder DAC.**
(S25 - Q5b OR, 04 marks) [Implied from syllabus]
(S22 - Q5b, 04 marks)
(W23 - Q5c, 07 marks)
(W22 - Q5a OR, 03 marks)
3. **Explain Successive Approximation ADC.**
(S25 - Q5c OR, 07 marks)
(W25 - Q5c OR, 07 marks)
(W23 - Q5c, 07 marks)
(W22 - Q5c OR, 07 marks)
4. **Explain R-2R Ladder DAC.**
(S25 - Q5b OR, 04 marks)
(W23 - Q5b, 04 marks)
(S22 - Q5c, 07 marks)

Other Important Questions (Newest to Oldest):

1. **Describe the operation of Weighted Resistor DAC.** (S25 - Q5b OR, 04 marks)
2. **Explain any one type of ADC with neat diagram.** (S25 - Q5c OR, 07 marks) (W25 - Q5c, 07 marks)
3. **Draw and explain Sample and Hold Circuit.** (W25 - Q5b, 04 marks)
4. **Explain any one type of DAC with a neat diagram.** (W25 - Q5c OR, 07 marks)
5. **Define Resolution and Quantization terms in context of A/D Converters.** (W22 - Q5a, 03 marks)
6. **A control valve has a linear variation of opening as the input voltage varies from 0 to 10V. A microcomputer outputs an 8-bit output word to control valve opening using an 8 bit D/A converter to generate the valve voltage. (1) find the reference voltage required to obtain full value opening (10 V) (2) find percentage of valve opening for a 1 bit change in the input word.** (W22 - Q5b, 04 marks)
7. **An analog transducer with a 0-10 V input is able to distinguish a change of 10 mV in its input signal. (1) calculate its resolution (2) Calculate the number of bits of an A/D converter so that the digital output has almost the same resolution as the transducer. The A/D converter uses a binary code. Calculate also (3) the quantization error and (4) the number of decision levels.** (W22 - Q5c, 07 marks)
8. **Give three comparisons between Weighted Resistor DAC and R-2R ladder DAC.** (W22 - Q5a OR, 03 marks)
9. **Explain Successive Approximation Type A/D Converter with suitable block diagram.** (W22 - Q5c OR, 07 marks)
10. **Provide a comprehensive explanation of Successive Approximation method for ADC.** (W23 - Q5c, 07 marks)
11. **Compare weighted Resistor DAC and R-2R ladder DAC.** (W23 - Q5c, 07 marks)
12. **List down the objectives of data acquisition system.** (W24 - Q5b, 04 marks)
13. **Describe operation of sample and hold circuits with relevant waveform.** (W24 - Q5c, 07 marks)
14. **Assess the need of amplifiers in sensing applications.** (W24 - Q5b OR, 04 marks)
15. **Explain the construction and working of single channel and multi-channel data acquisition system.** (W24 - Q5c OR, 07 marks)

16. A 10 bit ADC has a full scale of 10.230 V. When digital output is (11 1111 1111)₂, the quantization error of ADC in millivolts is. (S22 - Q5a, 04 marks)
17. Compare Weighted Resistor DAC and R-2R Ladder DAC. (S22 - Q5b, 04 marks)
18. With a neat circuit diagram, explain construction and working of 3 bit R-2R ladder DAC. (S22 - Q5c, 07 marks)
19. An 8-bit Unipolar DAC has a full scale voltage range from 0V to 7.68 V. If the digital input code is (10010110)₂, then the analog output is. (S22 - Q5a OR, 03 marks)
20. Explain Single Channel Data Acquisition System with suitable block diagram. (S22 - Q5b OR, 04 marks)
21. Explain operation of Successive Approximation ADC. (S22 - Q5c OR, 07 marks)
22. Explain Direct Digitization and processing. (W22 - Q5c, 07 marks)
23. Describe about DAQ? What is the need for DAQ? (W22 - Q5a OR, 03 marks)
