GUJARAT TECHNOLOGICAL UNIVERSITY

BE 6 SEMESTER – OLD PAPER – S22 TO S26 – QUESTION BANK

Subject Name & Code: Sensors and Transducers - 3161008

Chapter 1: Introduction to Electronics Measurement and Instrumentation

Repeated Questions:

1. Characteristics of Measurement Systems:

- **Q.** Define static characteristics (Sensitivity, Precision, Accuracy, Drift, Repeatability, Hysteresis, Range/Span, Resolution). **(SUMMER 2022, 3 Marks; WINTER 2022, 4 Marks; SUMMER 2023, 3 Marks; WINTER 2023, 3 Marks; SUMMER 2024, 3 Marks; WINTER 2025, 3 Marks)**
- **Q.** Define Speed of Response, Fidelity, Lag, and Dynamic Error. **(SUMMER 2024, 4 Marks; WINTER 2025, 4 Marks)**

2. Errors and Calibration:

- **Q.** Explain calibration technique(s). / Explain in detail Calibration techniques. **(WINTER 2022, 3 Marks; SUMMER 2026, 7 Marks)**
- **Q.** Explain types of errors / discuss types of errors in measurement system and how they are corrected. **(SUMMER 2022, 7 Marks; WINTER 2023, 4 Marks; SUMMER 2024, 7 Marks)**

3. Sensor Classification:

- **Q.** Give sensor classification / explain classification of sensors. **(WINTER 2022, 3 Marks; WINTER 2023, 7 Marks)**

Other Important Questions:

1. Sensors and Transducers:

- **Q.** Any two temperature sensors, any two pressure sensors, and any two light sensors can be listed. Explain any one of these six sensors in detail. **(WINTER 2025, 7 Marks)**
- **Q.** Explain Transducer with its characteristics and also give advantages and disadvantages. **(WINTER 2022, 7 Marks)**
- **Q.** Differentiate between Sensor and Transducer. **(WINTER 2023, 3 Marks)**
- **Q.** What is meant by two wire and three wire sensors? Give example for each type. **(SUMMER 2022, 4 Marks)**
- **Q.** Explain the function block of the measurement system with neat diagram. [Diagram required – refer to the original question paper] **(WINTER 2022, 4 Marks)**

2. Characteristics and Errors:

- **Q.** Distinguish Reproducibility and Repeatability. **(SUMMER 2026, 3 Marks)**
- **Q.** Mention any four dynamic characteristics and define them. **(SUMMER 2026, 4 Marks)**
- **Q.** Write short note on Limiting Errors. **(SUMMER 2023, 4 Marks)**
- **Q.** 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. **(SUMMER 2023, 7 Marks)**

Chapter 2: Temperature Sensors

Repeated Questions:

1. Thermistor:

- **Q.** How a thermistor differs from a thermocouple as a temperature sensor? **(SUMMER 2023, 3 Marks; WINTER 2025, 3 Marks)**
- **Q.** Summarize the construction, principle, and working of a thermistor and its resistance temperature characteristic. **(SUMMER 2022, 7 Marks OR; WINTER 2023, 7 Marks OR; WINTER 2025, 7 Marks)**

2. RTD and Thermocouple:

- **Q.** Differentiate characteristics of RTD and Thermistor. **(SUMMER 2022, 4 Marks; WINTER 2025, 4 Marks)**
- **Q.** Describe RTD and explain how it can be used to measure temperature / explain construction and working of RTD / explain RTD with advantages. **(WINTER 2022, 7 Marks; WINTER 2022, 3 Marks OR; WINTER 2023, 7 Marks; SUMMER 2026, 7 Marks OR)**
- **Q.** Write short note on Thermocouple / explain thermocouple construction and advantages, limitations. **(WINTER 2022, 7 Marks; SUMMER 2024, 4 Marks)**

Other Important Questions:

1. Temperature Sensor Theory:

- **Q.** Mention features of Thermistors. **(SUMMER 2026, 3 Marks)**
- **Q.** Write advantages and disadvantages of Thermistor. **(SUMMER 2023, 4 Marks)**
- **Q.** Compare RTD and thermocouple in detail. **(SUMMER 2024, 7 Marks)**
- **Q.** Discuss why thermocouples require a reference junction. **(SUMMER 2022, 3 Marks)**
- **Q.** Explain heat transfer using thermal conduction. **(WINTER 2022, 7 Marks)**

Chapter 3: Motion, Proximity and Ranging Sensors

Repeated Questions:

1. LVDT and RVDT:

- **Q.** Explain LVDT construction, working/principle, and characteristics with neat sketch/diagram. [Diagram required – refer to the original question paper] **(WINTER 2022, 7 Marks OR; SUMMER 2023, 7 Marks OR; WINTER 2023, 7 Marks; SUMMER 2024, 7 Marks OR; WINTER 2025, 7 Marks OR)**
- **Q.** Explain RVDT / basic structure of RVDT and its operation. **(WINTER 2022, 4 Marks; SUMMER 2026, 7 Marks)**

2. Potentiometer:

- **Q.** Explain construction and working principle of potentiometer. Evaluate its application as motion sensor. **(SUMMER 2022, 7 Marks; SUMMER 2023, 7 Marks)**

Other Important Questions:

1. Ranging, Proximity and Motion Sensors:

- **Q.** What is meant by LIDAR? Explain its various components, functionalities, and applications. **(WINTER 2025, 7 Marks)**
- **Q.** List advantages and disadvantages of Potentiometer. **(SUMMER 2026, 4 Marks)**
- **Q.** Write any three applications of LVDT. **(SUMMER 2024, 3 Marks)**
- **Q.** Explain Laser Range Sensor. **(WINTER 2023, 3 Marks)**
- **Q.** Write short note on Proximity Sensor. **(WINTER 2023, 4 Marks)**

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

Repeated Questions:

1. Strain Gauge, Tactile Sensor and Load Cell:

- **Q.** List/explain types/classification of Strain Gauges. **(WINTER 2022, 4 Marks OR; SUMMER 2024, 7 Marks - classification and one in detail; WINTER 2025, 3 Marks; SUMMER 2026, 3 Marks)**
- **Q.** Explain/define/application of Tactile Sensor. **(SUMMER 2022, 4 Marks OR; WINTER 2023, 3 Marks; WINTER 2025, 4 Marks OR)**
- **Q.** Give principle and construction of Load cell / write short note on Load cell. **(WINTER 2022, 3 Marks; WINTER 2023, 4 Marks)**

2. Magnetic Sensors:

- **Q.** Define Hall-effect and justify its applications / explain Hall Effect Sensor and list types. **(WINTER 2025, 3 Marks OR; SUMMER 2026, 4 Marks OR)**
- **Q.** Explain Magneto Resistive Effect / principle of Magneto Resistive Sensor, applications and advantages. **(SUMMER 2023, 3 Marks OR; SUMMER 2026, 7 Marks OR)**

Other Important Questions:

1. Strain Gauge and Capacitive/Inductive Transducers:

- **Q.** Compare Capacitive and Inductive transducers. **(WINTER 2025, 4 Marks)**
- **Q.** Discuss the operation of a Strain Gauge and evaluate its applications as a force sensor. **(WINTER 2025, 7 Marks OR)**
- **Q.** Write down the characteristics of Strain Gauge. **(SUMMER 2023, 3 Marks)**
- **Q.** Explain any one capacitive transducers. **(SUMMER 2024, 7 Marks OR)**
- **Q.** Define Gauge Factor of Strain Gauge. **(SUMMER 2022, 3 Marks)**

2. Piezoelectric Sensors:

- **Q.** List out suitable material for Piezo Electric Sensor. **(SUMMER 2026, 3 Marks OR)**
- **Q.** Explain the working of Piezoelectric Sensors. List the advantages and disadvantages of Piezoelectric Sensors. **(SUMMER 2023, 7 Marks)**
- **Q.** Define Piezo Electric effect. Draw the equivalent circuit of a Piezoelectric crystal and derive the transfer function of Piezo Electric transducer. [Diagram required – refer to the original question paper] **(SUMMER 2022, 7 Marks)**

3. Magnetic Sensors:

- **Q.** Explain types of Magnetic Sensor with its principle and advantages. **(WINTER 2023, 7 Marks)**

Chapter 5: Flow Measurement, Power Measurement, Optical Sensors

Repeated Questions:

1. Fiber Optic Sensor:

- **Q.** State advantages of Fiber Optic Sensor and its applications. **(SUMMER 2023, 4 Marks; SUMMER 2024, 3 Marks OR - applications; WINTER 2025, 3 Marks)**
- **Q.** Explain construction/working/principle/configuration of Fiber Optic Sensor. **(WINTER 2022, 7 Marks OR; SUMMER 2023, 7 Marks OR; SUMMER 2026, 7 Marks)**

2. LDR and Photo Conductive Cell:

- **Q.** Define Dark Resistance and list out materials used for construction of LDR. **(SUMMER 2022, 4 Marks; SUMMER 2023, 4 Marks OR; WINTER 2025, 4 Marks)**
- **Q.** Explain Photo Conductive Cell. **(WINTER 2023, 7 Marks OR - combined with Photo Voltaic Cell; SUMMER 2024, 4 Marks; WINTER 2025, 3 Marks OR)**

3. Flow Meters:

- **Q.** Explain ultrasonic flow meter. **(SUMMER 2022, 7 Marks OR; WINTER 2023, 4 Marks)**

Other Important Questions:

1. Optical Sensors:

- **Q.** List advantages and disadvantages of LDR. **(SUMMER 2026, 4 Marks)**
- **Q.** Explain LDR. **(SUMMER 2024, 4 Marks)**
- **Q.** Explain IR Sensor. **(WINTER 2023, 3 Marks)**
- **Q.** How can optical fiber be used for stress sensing? **(SUMMER 2022, 3 Marks OR)**

2. Flow and Power Measurement:

- **Q.** Compare Magnetic and Ultrasonic flow meter. **(SUMMER 2024, 3 Marks)**
- **Q.** Explain orifice meter for flow measurement. **(WINTER 2022, 4 Marks)**
- **Q.** Explain Power Factor meter. **(WINTER 2025, 4 Marks OR)**
- **Q.** Explain electronic energy meter. **(WINTER 2023, 3 Marks OR)**

Chapter 6: Special Sensors

Repeated Questions:

1. MEMS and Nano Sensors:

- **Q.** Compare MEMS Sensors and Nano Sensors. **(SUMMER 2022, 4 Marks OR; SUMMER 2024, 4 Marks; SUMMER 2026, 4 Marks OR)**

2. GPS, Drone and Bluetooth:

- **Q.** Explain GPS / short note on GPS / define GPS and list applications / advantages. **(WINTER 2022, 3 Marks OR; WINTER 2023, 4 Marks OR; SUMMER 2024, 4 Marks; WINTER 2025, 3 Marks OR)**
- **Q.** Write applications of sensors in drone. **(WINTER 2023, 3 Marks OR; SUMMER 2024, 3 Marks OR)**
- **Q.** Explain Bluetooth / Bluetooth Sensor. **(WINTER 2023, 3 Marks; SUMMER 2024, 4 Marks OR)**

Other Important Questions:

1. MEMS and Inclinometer:

- **Q.** List out any two applications which need MEMS sensors. **(WINTER 2025, 3 Marks)**
- **Q.** Explain MEMS sensor, working principle, also give advantage and applications. **(WINTER 2022, 7 Marks OR)**
- **Q.** List applications of Inclinometer. **(SUMMER 2026, 4 Marks)**

2. Smart Sensors and Other Sensors:

- **Q.** What is smart sensor? Mention application of smart sensor. **(WINTER 2022, 3 Marks)**
- **Q.** Show the block diagram of Smart Sensor Architecture. [Diagram required – refer to the original question paper] **(SUMMER 2022, 4 Marks)**
- **Q.** What is gyroscope sensor? Explain its type and give its application. **(WINTER 2022, 7 Marks)**
- **Q.** Explain Touch screen sensor. **(WINTER 2022, 4 Marks OR)**

Chapter 7: Analog Signal Conditioning

Repeated Questions:

1. Bridges:

- **Q.** Explain Kelvin double bridge method for measurement of low resistance with neat diagram. [Diagram required – refer to the original question paper] **(SUMMER 2023, 7 Marks; SUMMER 2024, 7 Marks OR; WINTER 2025, 7 Marks OR; SUMMER 2026, 7 Marks)**
- **Q.** Maxwell's bridge: working, advantages/limitations, and/or derive balance condition. [Diagram required – refer to the original question paper] **(SUMMER 2022, 7 Marks; SUMMER 2023, 7 Marks OR; SUMMER 2024, 7 Marks; SUMMER 2026, 4 Marks; SUMMER 2026, 7 Marks OR)**
- **Q.** Write limitations of Wheatstone bridge. **(SUMMER 2022, 3 Marks; SUMMER 2024, 3 Marks)**
- **Q.** Explain Hay's bridge / advantages and disadvantages of Hay's bridge. [Diagram required – refer to the original question paper] **(SUMMER 2024, 4 Marks OR; WINTER 2025, 7 Marks)**

2. Amplifiers and Attenuators:

- **Q.** Write requirements of Instrumentation Amplifier. **(SUMMER 2023, 4 Marks; SUMMER 2024, 3 Marks)**
- **Q.** Write applications of attenuators. **(SUMMER 2023, 3 Marks OR; WINTER 2023, 4 Marks OR)**

Other Important Questions:

1. Bridges:

- **Q.** What are the sources of errors in Wheatstone bridge? **(SUMMER 2026, 3 Marks)**
- **Q.** Suggest suitable detectors for AC bridges for the following frequency ranges: (1) 250 Hz to 4 KHz (2) Below 200 Hz (3) 10 Hz to 100 KHz. **(SUMMER 2023, 4 Marks OR)**
- **Q.** Classify the types of bridges used for measurement techniques and explain any one in detail. **(WINTER 2023, 7 Marks)**
- **Q.** Write advantages of AC Bridges. **(SUMMER 2022, 3 Marks OR)**
- **Q.** Draw Wien's Bridge Circuit and derive expression for the unknown element at balance. [Diagram required – refer to the original question paper] **(SUMMER 2022, 7 Marks OR)**

2. Amplifiers and Signal Conditioning:

- **Q.** Explain Non Inverting amplifier using Op-Amp. **(SUMMER 2026, 3 Marks OR)**
- **Q.** Explain Instrumentation Amplifier using Op-Amp. **(SUMMER 2026, 4 Marks OR)**
- **Q.** Draw an Inverting Amplifier using Op-Amp and derive formula for its gain. **(SUMMER 2023, 3 Marks)**
- **Q.** Define Amplifiers. **(WINTER 2022, 3 Marks)**
- **Q.** Explain Differential amplifier and Instrumentation amplifier. **(WINTER 2023, 7 Marks)**
- **Q.** What is signal conditioning and why is it required? **(WINTER 2025, 4 Marks OR)**

Chapter 8: Digital Signal Conditioning

Repeated Questions:

1. Sample and Hold Circuit:

- **Q.** Draw and explain Sample and Hold Circuit. [Diagram required – refer to the original question paper] **(WINTER 2022, 4 Marks; SUMMER 2023, 4 Marks OR; WINTER 2023, 4 Marks; SUMMER 2024, 3 Marks OR; WINTER 2025, 4 Marks)**

2. A/D Converter:

- **Q.** Explain Successive Approximation method/type A/D Converter with block diagram. [Diagram required – refer to the original question paper] **(SUMMER 2022, 7 Marks OR; SUMMER 2023, 7 Marks OR; WINTER 2023, 7 Marks OR; SUMMER 2024, 7 Marks; SUMMER 2026, 7 Marks OR)**

3. D/A Converters:

- **Q.** Compare Weighted Resistor DAC and R-2R Ladder DAC. **(SUMMER 2022, 4 Marks; SUMMER 2023, 3 Marks OR; SUMMER 2024, 7 Marks OR; SUMMER 2026, 3 Marks OR)**
- **Q.** Explain R-2R Ladder type DAC / construction and working of 3 bit R-2R ladder DAC. [Diagram required – refer to the original question paper] **(SUMMER 2022, 7 Marks; WINTER 2023, 4 Marks; SUMMER 2026, 7 Marks)**

Other Important Questions:

1. ADC and DAC Theory:

- **Q.** Explain any one type of ADC with a neat diagram. **(WINTER 2025, 7 Marks)**
- **Q.** Explain any one type of DAC with a neat diagram. **(WINTER 2025, 7 Marks OR)**
- **Q.** List out types of ADCs. **(SUMMER 2026, 3 Marks)**
- **Q.** Define Resolution and Quantization terms in context of A/D Converters. **(SUMMER 2023, 3 Marks)**

2. Data Acquisition:

- **Q.** Explain uses of data acquisition system. **(WINTER 2022, 4 Marks OR)**
- **Q.** Explain Direct Digitization and processing. **(WINTER 2022, 7 Marks)**
- **Q.** Describe about DAQ? What is the need for DAQ? **(WINTER 2022, 3 Marks OR)**
- **Q.** Explain Single Channel Data Acquisition System with suitable block diagram. [Diagram required – refer to the original question paper] **(SUMMER 2022, 4 Marks OR)**

3. Numerical Problems:

- **Q.** A control valve has a linear variation of opening as the input voltage varies from 0 to 10 V. 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. **(SUMMER 2023, 4 Marks)**
- **Q.** 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. **(SUMMER 2023, 7 Marks)**
- **Q.** 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 _____. **(SUMMER 2022, 3 Marks)**
- **Q.** 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 _____. **(SUMMER 2022, 3 Marks OR)**

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