



VALLIAMMAI ENGINEERING COLLEGE



SRM Nagar, Kattankulathur – 603 203.

DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING

QUESTION BANKSUBJECT : *OAN 551 SENSORS AND TRANSDUCERS*

YEAR /SEM : III /V

**UNIT-I INTRODUCTION**

Basics of Measurement – Classification of errors – Error analysis – Static and dynamic characteristics of transducers – Performance measures of sensors – Classification of sensors – Sensor calibration techniques – Sensor Output Signal Types.

**PART – A**

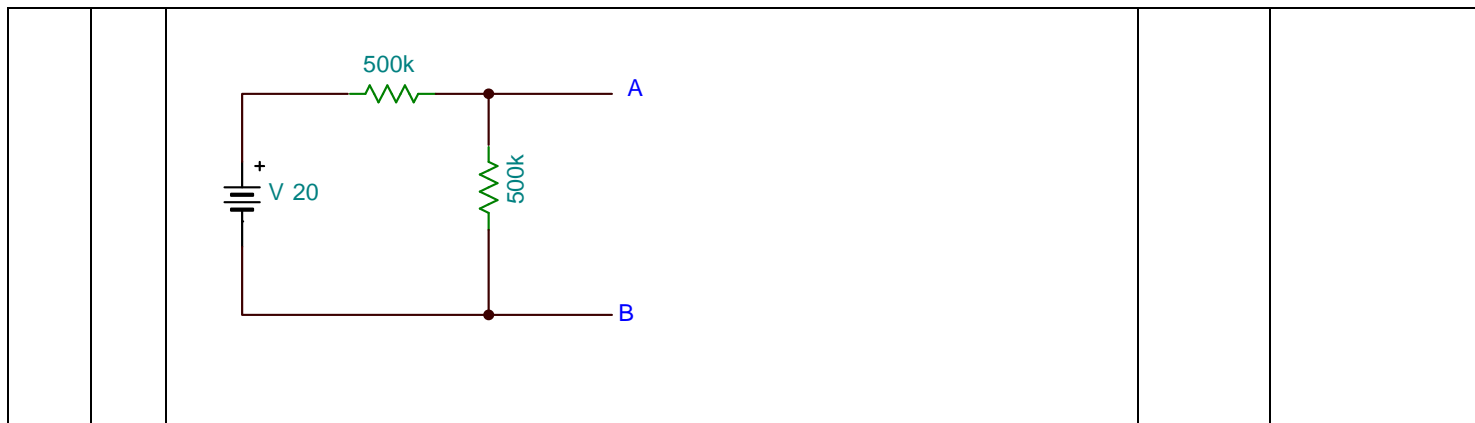
Q.N	Questions	BT Level	Competence
1.	What do you understand by the term 'Steady State Error'?	<b>BTL 1</b>	Remember
2.	Evaluate the purpose of measurement.	<b>BTL 5</b>	Evaluate
3.	The unknown resistance in a Wheatstone bridge is measured utilizing three known resistances such that $R_4 = R_2 R_3 / R_1$ . If the values of $R_1 = 100 \pm 0.5\%$ ohm, $R_2 = 500 \pm 0.5\%$ ohm, and $R_3 = 292 \pm 0.5\%$ ohm, determine the error in unknown resistance.	<b>BTL 1</b>	Remember
4.	List out the types of instrumental errors.	<b>BTL 1</b>	Remember
5.	Differentiate primary and Derived standards	<b>BTL 1</b>	Remember
6.	Identify What are the types of errors?	<b>BTL 6</b>	Create
7.	List out the sources of errors.	<b>BTL 2</b>	Understand

8.	What are the two different means adopted to avoid gross error?	<b>BTL 1</b>	Remember
9.	Why do you need static calibration and dynamic calibration	<b>BTL 3</b>	Apply
10.	The following 10 observations were recorded when measuring a voltage: 41.7,42.0,41.8,42.9,42.1,41.9,42.0,41.9,42.5,41.8. Find (a) The mean (b) The standard deviation.	<b>BTL 3</b>	Apply
11.	Differentiate between passive and active transducers. Give an example of each.	<b>BTL 4</b>	Analyze
12.	Compare limiting errors & component errors	<b>BTL 4</b>	Analyze
13.	Explain the differences between error and uncertainty. What are systematic and random errors?	<b>BTL 5</b>	Evaluate
14.	Define an inverse transducer. Give an example.	<b>BTL 1</b>	Remember
15.	Interpret the factors to be considered for selection of transducer for a particular Application.	<b>BTL 3</b>	Apply
16.	Define selectivity and specificity of sensors	<b>BTL 2</b>	Understand
17.	What are the output signals of sensors?	<b>BTL 6</b>	Create
18.	What is meant by two wire and three wire sensors? Give typical example for each type.	<b>BTL 4</b>	Analyze
19.	Classify sensors based on order and give example.	<b>BTL 2</b>	Understand
20.	Define Minimum Detectable Signal (MDS).	<b>BTL 2</b>	Understand

**PART – B**

1.	Discuss about the types of errors in measurement system and explain how they are corrected? <span style="float: right;"><b>(13)</b></span>	<b>BTL 1</b>	Remember
2.	(i) Explain the Normal or Gaussian curve of errors. <span style="float: right;"><b>(6)</b></span>	<b>BTL 4</b>	Analyze
	(ii) Explain about different types of systematic error. <span style="float: right;"><b>(7)</b></span>	<b>BTL 3</b>	Apply
3.	What is meant by error analysis? Explain statistical methods of error analysis With example. <span style="float: right;"><b>(13)</b></span>	<b>BTL 1</b>	Remember
4.	In a test, temperature is measured 100 times with variations in apparatus and	<b>BTL 4</b>	Analyze

		procedures. After applying the corrections, the results are:																																
		<table border="1"> <tr> <td>Tem</td> <td>397</td> <td>398</td> <td>399</td> <td>400</td> <td>401</td> <td>402</td> <td>403</td> <td>404</td> <td>405</td> </tr> <tr> <td>p °C</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Freq</td> <td>1</td> <td>3</td> <td>12</td> <td>23</td> <td>37</td> <td>16</td> <td>4</td> <td>2</td> <td>2</td> </tr> </table>	Tem	397	398	399	400	401	402	403	404	405	p °C										Freq	1	3	12	23	37	16	4	2	2		
Tem	397	398	399	400	401	402	403	404	405																									
p °C																																		
Freq	1	3	12	23	37	16	4	2	2																									
		Calculate the arithmetic mean, the average deviation, the standard deviation and the probable error. <b>(13)</b>																																
<b>5.</b>	<p>The following values were obtained from the measurement of current: 12.35A, 12.71 A, 12.48 A, 10.24 A, 12.63 A and 12.58 A.</p> <p>Calculate:</p> <p>a. The arithmetic mean</p> <p>b. The average deviation</p> <p>c. The standard deviation</p> <p>d. Variance. <b>(13)</b></p>		<b>BTL 3</b>	Apply																														
<b>6.</b>	<p>What are the classifications of instrument errors? Explain about the causes and remedies for each error in detail. <b>(13)</b></p>		<b>BTL 5</b>	Evaluate																														
<b>7.</b>	<b>(i)</b>	Enumerate the various sources of errors encountered in a measurement system. <b>(7)</b>	<b>BTL 5</b>	Evaluate																														
	<b>(ii)</b>	Classify the standards and give example for each level of standard. <b>(6)</b>																																
<b>8.</b>	Compare and Explain Static and dynamic characteristics of transducers / measurement system		<b>BTL 1</b>	Remember																														
<b>9.</b>	Analyse the various Performance measures of sensors. <b>(13)</b>		<b>BTL 4</b>	Analyze																														
<b>10.</b>	<b>(i)</b>	List and Discuss the desirable and undesirable static characteristics of transducers. <b>(7)</b>	<b>BTL 1</b>	Remember																														
	<b>(ii)</b>	What is the true value of the voltage across the terminals A and B ? What would a voltmeter of 20kΩ/V sensitivity read on the 50 V and 10 V ranges? <b>(6)</b>																																



11.	Explain classification of transducers in detail. (13)	BTL 2	Understand
12.	(i) Determine the sensitivity of a pressure gauge as a ratio of scale length to pressure if the gauge has radius of scale line as 100 mm and pressure of 0 to 50 pascals if displayed over an arc of 270 degree. The gauge has linear calibration curve. (4)	BTL 2	Understand
	(ii) Explain static characteristics of measuring instruments. (9)	BTL 3	Apply
13.	List the calibration methods. Explain about the static calibration in detail.(13)	BTL 6	Create
14.	(i) List out the Sensor Output Signal Types. (3)	BTL 2	Understand
	(ii) Explain various output signal types of sensors (10)		

**PART – C**

1.	Two resistors have the following rating :R1=36 ohms ± 5% and R2= 75 ohms ±5% . Deduce the limiting error when the resistors are connected in i) Series and ii) Parallel. (15)	BTL 5	Evaluate
2.	The following 10 observations were recorded when measuring a voltage in volts. 41.7, 42.0, 41.8, 42.0, 42.1, 41.9, 42.5, 42.0, 41.9, 41.8. Evaluate (1) Mean (2) Standard Deviation (3) Probable error (4) Mode. (15)	BTL 5	Evaluate
3.	The power factor in a circuit having sinusoidal voltage and current are determined by measuring current,voltage and power. The voltage is 150V on a voltmeter of 200V scale.The current is 7A on an ammeter of 10A scale. The power is 550W on a 1KW wattmeter . Ammeter and voltmeter are guaranteed to be accurate within ±0.2% of full scale and wattmeter ±0.5% of fullscale.  (i)To what % accuracy, the power factor obtained from the readings can be	BTL 6	Create

	guaranteed?  (ii) Obtain the amount of contribution of error by each instrument for the error obtained above in power factor reading. (15)		
4.	What are the primary and secondary signals in sensor or transducer classification? Give examples of magnetic- electric sensors and chemical – Electrical sensors. (15)	<b>BTL 4</b>	Analyze

**UNIT -II MOTION, PROXIMITY AND RANGING SENSORS**

Motion Sensors – Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro – Microsyn, Accelerometer.,– GPS, Bluetooth, Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR).

**PART – A**

1.	What is meant by Gray encoding? State the advantages of its.	<b>BTL 4</b>	Analyse
2.	Compare features of different motion sensors.	<b>BTL 5</b>	Evaluate
3.	Describe the principle of POT	<b>BTL 2</b>	Understand
4.	List out applications of the RF beacons.	<b>BTL 1</b>	Remember
5.	List the different arrangements of POT.	<b>BTL 3</b>	Apply
6.	Analyse the effects of loading in resistive Potentiometer.	<b>BTL 4</b>	Analyse
7.	Describe what is microsyn.	<b>BTL 1</b>	Remember
8.	Define the functions of resolver.	<b>BTL 1</b>	Remember
9.	List any three applications of proximity sensors.	<b>BTL 1</b>	Remember
10.	Define Synchros and list the types of synchro systems.	<b>BTL 3</b>	Apply
11.	Elaborate the applications of resolver?	<b>BTL 6</b>	create
12.	Compare capacitive and inductive transducers.	<b>BTL 4</b>	Analyze
13.	A Quartz piezo-electric Crystal having a thickness of 2 mm and voltage sensitivity of 0.055 V-m/N is subjected to a pressure of 1.5 MN/m <sup>2</sup> . Calculate	<b>BTL 6</b>	create

	the voltage output.		
14.	Write the modes of operation of piezo-electric crystals.	<b>BTL 2</b>	Understand
15.	Elaborate the applications of inductive transducers.	<b>BTL 1</b>	Remember
16.	What is meant by the term LIDAR?	<b>BTL 1</b>	Remember
17.	Why do we need accelerometer?	<b>BTL 5</b>	Evaluate
18.	Define GPS and list the applications.	<b>BTL 2</b>	Understand
19.	List the types of range sensing.	<b>BTL 2</b>	Understand
20.	How to apply the principle of ultrasonic for ranging?	<b>BTL 3</b>	Apply
<b>PART – B</b>			
1.	Explain the construction and working principle of potentiometer. Evaluate its application as motion sensor.	<b>BTL 5</b>	Evaluate
2.	(i) Explain the loading effect and the error caused in a POT. (7)	<b>BTL 1</b>	Remember
	(ii) Discuss Linearity and sensitivity of resistive Potentiometers. (6)		
3.	What is an LVDT? What are the parameters that can be measured by this? Describe with neat diagram and output characteristics the principle of its construction and operation. (13)	<b>BTL 2</b>	Understand
4.	Discuss the principle of operation of capacitive accelerometer with relevant diagram giving its various applications. (13)	<b>BTL 4</b>	Analyze
5.	(i) Explain the working of capacitive transducer with neat schematic. (7)	<b>BTL 6</b>	create
	(ii) Consider a non- conducting liquid in a tank and briefly explain how a capacitive transducer can be used for measuring its level. (6)		
6.	With neat diagram Discuss in detail the construction working of Synchros. (13)	<b>BTL 3</b>	Apply
7.	Discuss in detail the construction working and applications of RVDT (13)	<b>BTL 2</b>	Understand
8.	Explain the construction working and applications of resolver. (13)	<b>BTL 1</b>	Remember

9.	Discuss the principle of capacitive transducer and explain how it is applied for motion sensing. (13)	BTL 1	Remember
10.	Explain the principle of accelerometer with neat sketches. (13)	BTL 3	Apply
11.	Define Piezoelectric Principle and Explain the working of piezoelectric transducer. (13)	BTL 1	Remember
12.	Explain translational and rotary encoders with necessary sketches. (13)	BTL 2	Understand
13.	(i) What is meant by LIDAR? Explain its various components, functionalities and applications. (7)	BTL 4	Analyse
	(ii) Write a detailed technical note on the ultrasonic ranging. (6)		
14.	(i) Explain the working of GPS as range sensors. (7)	BTL 4	Analyse
	(ii) Analyse the working of Bluetooth range sensors. (6)		

**PART – C**

1.	<p>A linear resistance potentiometer is 50 mm long and is uniformly wound with a wire having a resistance of 10000 Ω. Under normal conditions, the slider is at the centre of the potentiometer. Find the linear displacement when the resistance of the potentiometer as measured by a Wheatstone bridge for the two cases are: (i) 3850 Ω (ii) 7560 Ω</p> <p>Are the two displacements in the same direction?</p> <p>If it is possible to measure a minimum value of 10 Ω resistance with the above arrangement, find the resolution of the potentiometer in mm. (15)</p>	BTL 6	create
2.	<p>A Capacitive transducer uses two quartz diaphragms of area 75- mm<sup>2</sup> separated by a distance of 3.5 mm. A pressure of 900 kN/m<sup>2</sup> when applied to the top diaphragm produces a deflection of 0.6 mm. The capacitance is 370 pF when no pressure is applied to the diaphragms. Find the value of capacitance after application of pressure 900 kN/m<sup>2</sup> (15)</p>	BTL 6	create
3.	<p>A LVDT output is recorded by a self-balancing potentiometric recorder having its natural frequency of 10 Hz and damping ratio of 0.707. The LVDT is excited by 10 V at 50 Hz power supply. Calculate the maximum frequency of</p>	BTL 6	create

	the displacement signal that can be recorded with an error of $\pm 2\%$ . (15)		
4.	Present a case study on comparison of various ranging methods. (15)	<b>BTL 6</b>	create

**UNIT- III FORCE, MAGNETIC AND HEADING SENSORS**

Strain Gauge, Load Cell, Magnetic Sensors –types, principle, requirement and advantages: Magneto resistive – Hall Effect – Current sensor Heading Sensors – Compass, Gyroscope, Inclometers.

<i>Q.NO</i>	<i>Questions</i>	<i>Level</i>	<i>Competence</i>
1.	Define gauge factor of strain gauge.	<b>BTL1</b>	Remember
2.	What are the various characteristic features of strain gauge load cell?	<b>BTL2</b>	Understand
3.	Differentiate semiconductor strain gauges and metal wire strain gauges.	<b>BTL1</b>	Remember
4.	Define piezoresistive effect.	<b>BTL1</b>	Remember
5.	List out various types of strain gauges.	<b>BTL1</b>	Remember
6.	A resistive wire strain gauge uses a soft iron wire of small diameter. The gauge factor is +4.2. Neglecting the piezoresistive effects, calculate poisons ratio.	<b>BTL3</b>	Apply
7.	Sketch a magnetic field sensor using $\Delta Y$ - effect.	<b>BTL6</b>	Creating
8.	Define $\Delta Y$ - effect in magnetic sensors.	<b>BTL3</b>	Apply
9.	What is meant by Villari effect?	<b>BTL2</b>	Understand
10.	Define Magneto resistive effect.	<b>BTL4</b>	Analyse
11.	Differentiate Matteucci effect, Villari effect and Wiedemann effect.	<b>BTL4</b>	Analyse
12.	How does compass works and state the principle behind it?	<b>BTL4</b>	Analyse



13.	State the principle of current sensor.	<b>BTL2</b>	Understand
14.	Define Hall effect and justify the applications of it.	<b>BTL4</b>	Analyse
15.	What is an inclinometer? List the applications of it.	<b>BTL1</b>	Remember
16.	What is Compass? Assess the significance and applications of it.	<b>BTL2</b>	Understand
17.	Compare different types of magnetic sensors.	<b>BTL4</b>	Analyse
18.	What is meant by Heading Sensors? List out the types.	<b>BTL3</b>	Apply
19.	Asses the advantages of magnetic sensors.	<b>BTL5</b>	Evaluate
20.	Assess the significance of Gyroscope?	<b>BTL5</b>	Evaluate

**PART-B**

<i>Q.NO</i>	<i>Questions</i>	<i>Level</i>	<i>Competence</i>
1.	(i) Derive the equation for gauge factor. (3)	<b>BTL2</b>	Understand
	(ii) Discuss the operation of strain gauge and evaluate its applications as force sensor. (10)	<b>BTL4</b>	Evaluate
2.	Illustrate about different types of strain gauges with neat sketch. (13)	<b>BTL2</b>	Understand
3.	(i) Evaluate the principle of operation of load cell for the measurement of force. (9)	<b>BTL4</b>	Analyse
	(ii) Analyze the advantages of semiconductor strain gauges. (4)	<b>BTL4</b>	Analyse
4.	Discuss the principle of operation of a magneto resistive transducer with appropriate diagram. What are the various parameters that can be measured by this transducer? (13)	<b>BTL4</b>	Analyse
5.	(i) What is gyroscope? Explain the principle of operation and properties of it with relevant diagrams. (7)	<b>BTL1</b>	Remember
	(ii) On What factors and parameters of the sensor does the Hall voltage output depend for a given field condition. (6)	<b>BTL1</b>	Remember

6.	(i)	What are the different types of magnetic sensors? On what principles do they work? Outline briefly. (6)	<b>BTL2</b>	Understand
	(ii)	What is $\Delta Y$ - effect? How is it used in practice for magnetic field sensing? What materials are specifically suitable for the purpose? (7)	<b>BTL4</b>	Evaluate
7.		Describe with diagrams, the principle of operation of a coaxial type torque sensor. What is an inactive zone in such sensor? Why is it provided? (13)	<b>BTL4</b>	Evaluate
8.		Describe the basic principle of a Hall device and show how can it be used as magnetic field sensor? (13)	<b>BTL4</b>	Analyse
9.	(i)	Describe the operation of hall effect current sensor. (7)	<b>BTL2</b>	Understand
	(ii)	List out and analyze the various effects governing magnetic sensing. (6)	<b>BTL4</b>	Analyse
10.		Evaluate the need for magnetic sensors also explain the types, principle, requirement and advantages of magnetic sensors. (13)	<b>BTL4</b>	Analyse
11.	(i)	Elaborate the features and applications of compass. (5)	<b>BTL4</b>	Evaluating
	(ii)	Discuss the principle of working of Active semiconductor magnetic sensors. (8)	<b>BTL2</b>	Understand
12.	(i)	Explain the principle behind Electrolytic spirit level transducer. (6)	<b>BTL2</b>	Understand
	(ii)	Brief the features and applications of inclinometers. (7)	<b>BTL2</b>	Understand
13.	(i)	Discuss the principle and operation of any one form of gyroscope (7)	<b>BTL4</b>	Analyse
	(ii)	Differentiate Free gyroscope and Single-axis restrained gyro. (6)	<b>BTL4</b>	Analyse
14.		Explain the working of inclinometers or tilt sensors. (13)	<b>BTL2</b>	Understand

**PART -C**

1	(i)	How does the gauge factor of a semiconductor strain gauge vary with doping level? Discuss with help of diagrams. (8)	<b>BTL4</b>	Analyse
	(ii)	Describe a piezoresistive type strain gauge sensor appending appropriate diagrams. (7)		
2		Develop the principle of anisotropic magnetoresistive sensors. How is it used in sensing magnetic field? A metallic magnetoresistor is placed in magnetic field	<b>BLT6</b>	Create

	with its length perpendicular to the field. How does the resistance vary with this field. (15)		
3	(i) How is performance of Hall sensor evaluated? What are the primary and secondary sensitivities? (7) (ii) An Hall effect element used for measuring a magnetic field strength gives an output voltage of 10.5 mV. The element is made of silicon and is 2.5 mm thick and carries a current of 4 A. The Hall coefficient is $4.1 \times 10^6 \text{Vm/A-wb/m}^2$ . Calculate the magnetic field strength. (8)	BTL4	Analyse
4	Analyse the performance measures of different heading sensors giving the merits, demerits and applications. (15)	BTL4	Analyse

**UNIT- IV OPTICAL, PRESSURE AND TEMPERATURE SENSORS**

Photo conductive cell, photo voltaic, Photo resistive, LDR – Fiber optic sensors – Pressure –Diaphragm, Bellows, Piezoelectric – Tactile sensors, Temperature – IC, Thermistor, RTD, Thermocouple. Acoustic Sensors – flow and level measurement, Radiation Sensors - Smart Sensors - Film sensor, MEMS & Nano Sensors, LASER sensors.

**PART –A**

<i>Q.N.</i>	<i>Questions</i>	<i>BT Level</i>	<i>Competence</i>
1.	Define Dark resistance and list out some materials used for the construction of LDR.	BTL 3	Apply
2.	Estimate the advantages and disadvantages of Thermistor.	BTL 6	Create
3.	How a thermistor differs from a thermocouple as a temperature sensor?	BTL 3	Apply
4.	What is meant by tactile sensor?	BTL 1	Remember
5.	Define the pin outs and the merits of IC used for temperature measurement.	BTL 4	Analyze
6.	Determine the pressure sensitivity of a quartz piezoelectric transducer of thickness 2.5 mm. the voltage sensitivity of quartz is $50 \times 10^3 \text{Vm/N}$ .	BTL 5	Evaluate
7.	State advantages of fiber optic sensors and its application.	BTL 1	Remember
8.	Discuss why the reference junction is needed in thermocouples.	BTL 6	Create
9.	Show how force summing devices help in pressure measurement.	BTL 3	Apply
10.	Define Seebeck effect and Thompson effect and state the significance of them.	BTL 1	Remember

11.	Determine the types of thermocouples and materials used for constructing thermocouples.	<b>BTL 5</b>	Evaluate
12.	Differentiate the characteristics of RTD and Thermistor.	<b>BTL 2</b>	Understand
13.	List out any two applications that need MEMS sensors..	<b>BTL 1</b>	Remember
14.	State the properties of piezoelectric crystals.	<b>BTL 2</b>	Understand
15.	What is the principle of Piezoelectric transducer?	<b>BTL 2</b>	Understand
16.	Point out the important features of smart transducer.	<b>BTL 4</b>	Analyze
17.	Compare MEMS sensors and Nano Sensors.	<b>BTL 5</b>	Evaluate
18.	State the advantages of MEMS.	<b>BTL 4</b>	Analyze
19.	Show the block diagram of architecture of smart sensor.	<b>BTL 2</b>	Understand
20.	Give the standards available for Smart transducer and its interface.	<b>BTL 2</b>	Understand

**PART – B**

1.	(i) Discuss the photovoltaic mode of operation of a photo diode with its diagram and volt- ampere characteristics. (7)	<b>BTL 4</b>	Analyze
	(ii) Give the constructional and functional details of thermocouple with the relevant physical laws and diagrams. (6)		
2.	(i) Explain the working of different types of pressure diaphragms and bellows with diagrams. (7)	<b>BTL 1</b>	Remember
	(ii) Discuss the principle of operation of fiber optic sensor with neat diagram. (6)		
3.	Brief some primary and secondary transducers involved in the measurement of pressure and explain how pressure is measured. (13)	<b>BTL 1</b>	Remember
4.	(i) Discuss the typical advantages and applications that needs MEMS sensors. (6)	<b>BTL 2</b>	Understand
	(ii) Describe what is meant by thick film and thin film technology. (7)		
5.	Define piezoelectric effect. Draw the equivalent circuit of a piezoelectric crystal and derive the transfer function of piezoelectric transducer. (13)	<b>BTL 3</b>	Apply
6.	(i) Discuss any one fibre optic sensor for displacement measurement. (7)	<b>BTL 4</b>	Analyze
	(ii) Describe about MEMS technology. Explain different manufacturing. (6)		
7.	How is optical fibre used for stress sensing? Describe a microbend sensor and discuss its operation. (13)	<b>BTL 4</b>	Analyze
8.	Discuss the principle behind the use of LASER in flow measurement and Explain LASER Doppler Velocimeter. (13)	<b>BTL 6</b>	Create
9.	Describe the RTD and explain how it can be used to measure temperature. (13)	<b>BTL 2</b>	Understand

10.	Summarize the construction, principle, working of thermistor and its resistance temperature characteristics. (13)	BTL 2	Understand
11.	Explain the principle, construction, working and applications of ultrasonic Flow meters with neat sketches. (13)	BTL 1	Remember
12.	Illustrate with a neat block diagram the construction and operation of a smart transducer and outline its interface standard. (13)	BTL 1	Remember
13.	Discuss the construction, principle, working and features of Nano –sensors. (13)	BTL 3	Apply
14.	(i) Explain Ultrasonic Liquid Level Measurement System. (7) (ii) Discuss the principle and features of Electromagnetic Flow Meters(6)	BTL 5	Evaluate

**PART – C**

1.	Consider a fibre optic probe and design a displacement sensor for transducing displacement in to equivalent electric signal by making necessary assumptions and plot the characteristics curve of the designed sensor. (15)	BTL 5	Evaluate
2.	A thermistor has a resistance of 3980Ω at the ice point(0°C) and 794Ω at 50°C. The resistance temperature relationship is given by $R_T = aR_0 \exp(b/T)$ . Calculate the range of resistance to be measured in case the temperature varies from 40°C to 100°C. (15)	BTL 6	Create
3.	Design a temperature monitoring system for pasteurization processing for milk and Discuss the features of the system.	BTL 5	Evaluate
4.	Analyse the different standards involved in Smart Transducer interface, and also discuss about the need for standardisation. (15)	BTL 5	Evaluate

**UNIT- V SIGNAL CONDITIONING and DAQ SYSTEMS**

Amplification – Filtering – Sample and Hold circuits – Data Acquisition: Single channel and multi channel data acquisition – Data logging - applications - Automobile, Aerospace, Home appliances, Manufacturing, Environmental monitoring.

**PART – A**

<i>Q. No</i>	<i>Questions</i>	<i>BT Level</i>	<i>Competence</i>
1.	List the types of amplifiers that can be used with sensors.	BTL 1	Remember
2.	Point out the need for amplifiers in sensing applications.	BTL 4	Analyze
3.	What is meant by aliasing?	BTL 1	Remember

4.	Describe the types and need for filters.	<b>BTL 1</b>	Remember
5.	Generalize the significance of Instrumentation amplifier with conventional amplifiers.	<b>BTL 6</b>	Create
6.	Find the aperture time required to digitize a 500 Hz signal to 10 bits resolution.	<b>BTL 2</b>	Understand
7.	Compare analog filters and digital filters.	<b>BTL 2</b>	Understand
8.	Illustrate the function of sample and Hold circuits.	<b>BTL 3</b>	Apply
9.	Define PZT sensor. What for is it used?	<b>BTL 1</b>	Remember
10.	Demonstrate the application of static pressure sensors in aerospace applications.	<b>BTL 3</b>	Apply
11.	What are the sensors used and application areas in Home appliance systems?	<b>BTL 1</b>	Remember
12.	Illustrate the components of data acquisition system.	<b>BTL 3</b>	Apply
13.	Justify the need for sensors in automobiles.	<b>BTL 4</b>	Analyze
14.	Point out the major areas where sensing is required in automobile systems.	<b>BTL 4</b>	Analyze
15.	Write the sensors involved in on board automobile.	<b>BTL 2</b>	Understand
16.	Write the importance of position sensing in automobiles.	<b>BTL 5</b>	Evaluate
17.	Compare sensors used for environmental monitoring.	<b>BTL 5</b>	Evaluate
18.	Define the term data logging evaluate the benefits of data logging.	<b>BTL 5</b>	Evaluate
19.	Define what is ecological studies of Air. List various parameters involved.	<b>BTL 1</b>	Remember
20.	State the different sensors used in production processes.	<b>BTL 2</b>	Understand
<b>PART – B</b>			
1.	What is signal conditioning and why it is required? Develop the block diagram of a DC signal conditioning system and explain the functions of each block. (13)	<b>BTL 6</b>	Create
2.	Draw and Explain Instrumentation amplifier with neat diagram and derive its gain. (13)	<b>BTL 1</b>	Remember
3.	(i) Draw and explain sample and hold circuit. (8) (ii) What is signal Conditioning and why is it required. (5)	<b>BTL 4</b>	Analyze
4.	Define Q factor and discuss the working of different filter categories. (13)	<b>BTL 1</b>	Remember
5.	(i) Why ADC and DAC are needed. (3) (ii) Explain any one type of ADC with neat diagram (10)	<b>BTL 2</b>	Understand
6.	(i) Explain the reason for using 4-20 mA current loop in the 2 wire transmitter. (5) (ii) Explain the working of 4-20 mA current loop converter. (8)	<b>BTL 5</b>	Evaluate

7.	Discuss the function of Single Channel and Multi Channel Data Acquisition System with block diagram. (13)	BTL 4	Analyze
8.	Discuss the importance of Data logging and Explain the components of a Data logger with neat diagram. (13)	BTL 3	Apply
9.	(i) Discuss the role of static pressure sensors in aerospace applications.(6) (ii) Explain how Direction of Air flow is sensed in aircrafts. (7)	BTL 2	Understand
10.	(i) Draw the sketch of a pyroelectric IR sensor as used in microwave oven. What is the material used for developing this sensor? (7) (ii) How water level is measured in washing machines? Sketch a sensor and Explain its operation. (6)	BTL 4	Analyze
11.	Describe three types of Oxygen sensors used in automobiles comparing their advantages and operations with help of V-I characteristics. (13)	BTL 1	Remember
12.	Discuss the importance of Environmental monitoring and explain the sensors involved in that. (13)	BTL 3	Apply
13.	(i) Define Eco Hazard And Explain how it affects living being with help of a chart. (7) (ii) Brief about sensing of environmental pollution. (6)	BTL 1	Remember
14.	Explain the functions of various sensors in an automated manufacturing process. (13)	BTL 2	Understand
<b>PART – C</b>			
1.	Evaluate the importance, performance and applications of various sensors in Automobile industries. (15)	BTL 6	Create
2.	Present a case study on Medical diagnostic sensors giving the features and advantages. (15)	BTL 5	Evaluate
3.	(i) A simple RC low-Pass filter is to be designed that the output voltage be attenuated by 3 db at 50 Hz. Calculate the time constant and suitable values of R and C. (8) (ii) A bandpass filter consists of two RC networks connected in cascade. The Low pass Filter consists of a resistor $R_1=10\text{ k}\Omega$ and $C_1=100\text{pF}$ and the high pass Filter consists of a resistor $R_2=1\text{M}\Omega$ and $C_2=0.01\mu\text{F}$ . Find the lower and upper cutoff frequencies and the pass band gain. (7)	BTL 6	Create
4.	Evaluate the applications of various sensors in aerospace applications and discuss the technique of computation of air speed on aircraft by measuring the static pressure, total pressure and temperature. (15)	BTL 5	Evaluate