SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF

ELECTRICAL AND ELECTRONICS ENGINEERING

QUESTION BANK

EE3463 – MEASUREMENTS AND INSTRUMENTATION

Regulation – 2023

Academic Year 2024-2025 (EVEN)

Prepared by

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SUBJECT: EE3463– MEASUREMENTS AND INSTRUMENTATION

SEM / YEAR:IV/II

UNIT I - CONCEPTS OF MEASUREMENTS				
Instruments: classification, applications – Elements of a generalized measurement system - Static and dynamic characteristics - Errors in measurement -Statistical evaluation of measurement data.				
PART – A				
Q.No.	**Questions**	**BT Level**	**Competence**	**COs**
1.	What are the basic functional elements of an instrument?	**BTL 4**	**Create**	**CO1**
2.	Briefly explain the role of primary sensing element.	**BTL 5**	**Evaluate**	**CO1**
3.	What are defection and null output instruments?	**BTL 4**	**Analyse**	**CO1**
4.	Give the classification of secondary instruments	**BTL 3**	**Apply**	**CO1**
5.	Compare Resolution and Precision.	**BTL 3**	**Apply**	**CO1**
6.	Define the term "Sensitivity" of an Instrument.	**BTL 1**	**Knowledge**	**CO1**
7.	Define the Static characteristics of an Instrument.	**BTL 5**	**Evaluate**	**CO1**
8.	The true value of a voltage is 100V. The values indicated by a measuring instrument are 104, 103,105,103 and 105V. Calculate the Accuracy and Precision of the measurement.	**BTL 6**	**Create**	**CO1**
9.	Define Dynamic characteristics of an Instrument.	**BTL 4**	**Analyse**	**CO1**
10.	A Voltmeter reads 152 volts for a particular measurement. If the true value of the measurement is 154 volts, Determine the percentage static relative error and static correction.	**BTL 1**	**Knowledge**	**CO1**
11.	Define fidelity.	**BTL 2**	**Understand**	**CO1**
12.	State the different types of standards in an Instrument.	**BTL 1**	**Knowledge**	**CO1**
13.	Enumerate the term calibration employed in instruments.	**BTL 4**	**Analyse**	**CO1**
14.	Explain Absolute error of measurement?	**BTL 3**	**Apply**	**CO1**
15.	Define Limiting error. Derive the expression for Relative limiting error.	**BTL 4**	**Analyse**	**CO1**
16.	What are gross errors?	**BTL 6**	**Create**	**CO1**
17.	What is Average deviation? What does indicate on a measuring instrument?	**BTL 6**	**Create**	**CO1**
18.	Distinguish between Gravity control and Spring Control.	**BTL 5**	**Evaluate**	**CO1**
19.	Express the Data presentation element.	**BTL 2**	**Understand**	**CO1**
20.	Illustrate the Accuracy as 'Percentage of full scale reading'.	**BTL 2**	**Understand**	**CO1**
21.	Define (i) Resolution (ii) Static Sensitivity.	**BTL 1**	**Knowledge**	**CO1**
22.	What is meant by calibration of the instrument?	**BTL 1**	**Knowledge**	**CO1**
23.	Draw the functional elements of measurements system.	**BTL 1**	**Knowledge**	**CO1**
24.	List any 4-static characteristics of measurement system.	**BTL 1**	**Knowledge**	**CO1**
PART – B				

1.	(i) Explain the functional elements of an instrument with a neat block diagram (ii) Define accuracy and reproducibility of an instrument and explain.	(16)	**BTL 2**	**Understand**	**CO1**
2.	Discuss the various classification of instruments in detail	(16)	**BTL 2**	**Understand**	**CO1**
3.	Describe the static and dynamic characteristics of measuring instruments.	(16)	**BTL 1**	**Knowledge**	**CO1**
4.	(i) What are the different types of error? Explain how to eliminate errors in instrument. (ii) An electric current of 3 Ampere is flowing through a resistanceof10ohms.Itwasfoundthattheresistancewas0.2% greater than what was specified as rated and the ammeter measurementwas0.5%more than the true value. Determine the relative error in power measurement.	(8) (8)	**BTL6** **BTL6**	**Create** **Create**	**CO1** **CO1**
5.	(i) Define and explain the following static characteristics of an instrument. (a) Accuracy (b) Resolution (c) Sensitivity (d) Linearity (ii)Explain the types of static errors possible in an instrument.	(8) (8)	**BTL 1** **BTL 2**	**Knowledge** **Understand**	**CO1** **CO1**
6.	A circuit was tuned for resonance by eight different students and the value of resonant frequency in kHz were recorded as 532, 548, 543, 535, 546, 531,543 and 536. calculate (i) Arithmetic mean (ii) Deviation (iii) Standard deviation (iv) Average deviation	(16)	**BTL 5**	**Evaluate**	**CO1**
7.	By using a micrometer screw, the following readings were taken of a certainlength:1.34, 1.38, 1.56, 1.47, 1.42, 1.44, 1.53,1.48,1.40,1.59 mm. Formulate the necessary equations and calculate the following: (i) Arithmetic mean (ii) Average deviation (iii) standard deviation and (iv) variance	(16)	**BTL 4**	**Analyse**	**CO1**
8.	Define the following terms in the context of normal frequency distribution of data: (i) Mean value (ii) Deviation (iii) Average deviation (iv) Variance (v) Standard deviation.	(16)	**BTL 2**	**Understand**	**CO1**
9.	Classify and explain the different types of error and also mention its compensation methods.	(16)	**BTL 2**	**Understand**	**CO1**
10.	(i) Explain the Classification of Standards in detail. (ii) Discuss the Significance of Calibration.	(8) (8)	**BTL 1**	**Knowledge**	**CO1**
11.	(i) Discuss the Different types of Standards and Errors of Measurements. (ii) Discuss in detail about the Sources of errors in Measurement Techniques.	(8) (8)	**BTL3** **BTL3**	**Apply** **Apply**	**CO1** **CO1**
12.	The following values were obtained from the measurements of	(16)	**BTL 6**	**Create**	**CO1**

	the values of 147.2, 147.4, 147.9, 147.7, 147.5, 147.6, and 147.5. Calculate (i) arithmetic mean (ii) standard deviation (iii) The probable error of average of Ten readings				
13.	(i) Discuss with a neat sketch and explain the working principle of PMMC Instrument. (ii) AmeterAhasarangeof0-100Vandamultiplierresistance of 25ohm.The meter B has range of 0-1000V and a multiplier resistance of 150KΩ. Both meter have basic resistance of 1KΩ.Which meter is more sensitive?	(8) (8)	**BTL1** **BTL4**	**Knowledge** **Apply**	**CO1** **CO1**
14.	Explain in detail the types of errors and sources of error in measurement technique.	(16)	**BTL 5**	**Evaluate**	**CO1**
15.	A set of Independent current measurements were taken by six observer and were recorded as 12.8 A,12.2A,12.5A,13.1A,12.9A and 12.4A. (i) Arithmetic mean (ii) Deviation from mean (iii) Average deviation (iv) standard deviation and variance	(16)	**BTL 1**	**Knowledge**	**CO1**
16.	(i) What is a standard? Explain the different type standards. (ii) Explain in details about calibration technique.	(8) (8)	**BTL3**	**Apply**	**CO1**
17.	(i) Describe the functional elements of an instrument withblock diagram, (ii) Explain the dynamic characteristics of an instrument indetails.	(8) (8)	**BTL1** **BTL4**	**Knowledge** **Apply**	**CO1** **CO1**

UNIT II -MEASUREMENT OF PARAMETERS IN ELECTRICAL SYSTEMS

Classification of instruments – moving coil and moving iron meters – Induction type, dynamometer type watt meters – Energy meter – Megger – Instrument transformers (CT & PT).

PART – A

Q.No	Questions	BT Level	Competence	COs
1.	How the measuring instruments can be classified?	**BTL 2**	**Understand**	**CO2**
2.	List out various causes in which the error of Electro dynamo type wattmeter.	**BTL 2**	**Understand**	**CO2**
3.	What are the Analog instruments?	**BTL 1**	**Knowledge**	**CO2**
4.	Illustrate the Types of analog ammeter used for Instrumentation.	**BTL 6**	**Create**	**CO2**

5.	Write the torque Equation for the moving iron instruments		**BTL 4**	**Analyse**	**CO2**
6.	Mention any 4-applications of Multimeter.		**BTL 1**	**Knowledge**	**CO2**
7.	Why the ordinary Watt-meters are not suitable for Low power factor circuits?		**BTL 1**	**Knowledge**	**CO2**
8.	How does one extend the range of Ammeter and Voltmeter?		**BTL 1**	**Knowledge**	**CO2**
9.	Specify the use of copper shading bands. Where is it placed in the Energy meter?		**BTL 4**	**Analyse**	**CO2**
10.	Construct the gravity control system with neat diagram.		**BTL 2**	**Understand**	**CO2**
11.	Illustrate the types of instruments used as ammeters and voltmeters.		**BTL 3**	**Apply**	**CO2**
12.	Describe the basic principle of PMMC instruments.		**BTL 4**	**Analyse**	**CO2**
13.	Define Creeping in Energy meter.		**BTL 1**	**Knowledge**	**CO2**
14.	Draw the block diagram of attraction type moving iron instrument.		**BTL 3**	**Apply**	**CO2**
15.	Distinguish between radial vane type and coaxial vane type.		**BTL 3**	**Apply**	**CO2**
16.	Name the various errors in the moving instruments.		**BTL 5**	**Evaluate**	**CO2**
17.	Which torque is absent in energy meter? Why?		**BTL 5**	**Evaluate**	**CO2**
18.	Draw the basic diagram for Electro Dynamo type Wattmeter.		**BTL 5**	**Evaluate**	**CO2**
19.	Mention the main elements of Induction type Energy Meter.		**BTL 4**	**Analyse**	**CO2**
20.	List out the Various causes which occur errors in a Dynamometer Wattmeter		**BTL 1**	**Knowledge**	**CO2**
21.	List out the methods used for Measurement of Iron loss in Ferromagnetic materials.		**BTL 1**	**Knowledge**	**CO2**
22.	List the advantages of instrument transformers		**BTL 3**	**Apply**	**CO2**
23.	Point out any two applications of CT and of PT.		**BTL 3**	**Apply**	**CO2**
24.	Definetransformer ratio of an Instrumentation Transformer (IT).		**BTL 5**	**Evaluate**	**CO2**
PART – B					
1.	Discuss the Construction and its Working principle of Electrodynamometer type Wattmeter.	(16)	**BTL 4**	**Analyse**	**CO2**
2.	Discuss with Circuit and Phase diagram, describe the working of Single-phase AC Energy Meter.	(16)	**BTL 5**	**Evaluate**	**CO2**
3.	State Blondel's theorem and explain how the power measurement using two wattmeter methods.	(16)	**BTL2**	**Understand**	**CO2**
4.	Describe the Construction and Working of Permanent Magnet Moving Coil Instrument. Also Derive the expression for deflection.	(16)	**BTL 2**	**Understand**	**CO2**
5.	Obtain the Mathematical expression for deflecting torque and Controlling t o r q u e for the DC Ammeter. Also write the advantages and disadvantages.	(16)	**BTL 3**	**Apply**	**CO2**
6.	Discuss the working principle of operation of Electrodynamometer type of Instruments with its constructional diagram.	(16)	**BTL 6**	**Create**	**CO2**

7.	(i) Explain the Methods of turns compensation used in current Transformers to reduce ratio error. (ii) Explain the term "loading" in voltmeter and give the method to remove the adverse effect of the same.	(8) (8)	**BTL3** **BTL2**	**Apply** **Understand**	**CO2** **CO2**
8.	(i) The Coil of instrument has 42.5 turns. The mean width of the coil is 2.5cm and the axial length of the coil is 2 cm. If the flux density is 0.1 Wb/m2, Calculate the torque on the moving coil in NM (ii) A 100/5A current transformer having a rated burden of 25 VA has an iron loss of 0.4W and a magnetizing current of 2 A. Calculate its ratio error and phase angle error when supply in grated output current.	(8) (8)	**BTL3**	**Apply**	**CO2**
9.	(i) Explain the Moving iron attraction type instrument. (ii) Infer the Moving iron repulsion type instrument.	(8) (8)	**BTL3**	**Apply**	**CO2**
10.	Explain the construction and working principle of megger instrument.	(16)	**BTL3**	**Apply**	**CO2**
11	(i) Discuss the effect of the following on the error of current Transformer a) Change of primary winding circuit and b) Change in secondary winding circuit burden. (ii) How is multi-meter used to measure different parameters? Explain with suitable diagram.	(8) (8)	**BTL 3**	**Apply**	**CO2**
12.	Illustrate the following (i) Current transformer. (ii) Potential transformer.	(8) (8)	**BTL2**	**Understand**	**CO2**
13.	Describe the constructional and working of an induction type wattmeter. Also derive an expression for the average torque which is proportional to power.	(16)	**BTL 3**	**Apply**	**CO2**
14.	Describe the construction details and working of Single Phase Induction Type Energy meter.	(16)	**BTL 2**	**Understand**	**CO2**
15.	Discuss briefly the three types of operating torque needed for the satisfactory operation of the indicating instruments.	(16)	**BTL 3**	**Apply**	**CO2**
16.	Discuss in detail, about the working principle characteristics of CT with its phasor diagram.Explain the operating principle of instrument transformer.	(16)	**BTL 3**	**Apply**	**CO2**
17.	Explain with neat sketch types of instrumentation transformer.	(16)	**BTL 6**	**Create**	**CO2**

UNIT III - AC/DC BRIDGES AND INSTRUMENTATION AMPLIFIERS

Wheatstone bridge, Kelvin double bridge - Maxwell, Hay, Wien and Schering bridges –Errors and compensation in A.C. bridges - Instrumentation Amplifiers.

PART – A

Q.No.	Questions	BT Level	Competence	COs
1.	Describe the types of bridges.	**BTL 3**	**Apply**	**CO3**
2.	Evaluate the Thevenin's equivalent circuit of Wheatstone bridge.	**BTL 4**	**Analyse**	**CO3**
3.	With the neat circuit diagram, illustrate the balanced equation of Wheatstone bridge.	**BTL 1**	**Knowledge**	**CO3**
4.	Distinguish between Wheatstone bridge and Kelvin's bridge?	**BTL 4**	**Analyse**	**CO3**

5.	How Maxwell's bridge differ from Anderson bridge, although both are used for measuring inductance?	**BTL 3**	**Apply**	**CO3**
6.	Draw the circuit diagram write the expression for unknown inductance and its resistance of Anderson's bridge.	**BTL 2**	**Understand**	**CO3**
7.	Write the necessary balance condition for a Schering bridge.	**BTL 4**	**Analyse**	**CO3**
8.	Evaluate why there are two conditions of balance in AC bridges?	**BTL 4**	**Analyse**	**CO3**
9.	Which bridge is used to measure incremental inductance? Write the expression.	**BTL 3**	**Apply**	**CO3**
10.	List the application of AC bridge.	**BTL 4**	**Analyse**	**CO3**
11.	Generalize the active and passive bridge circuits?	**BTL 3**	**Apply**	**CO3**
12.	Give the relationship between the bridge balance equation of DC bridge and AC bridge	**BTL 1**	**Knowledge**	**CO3**
13.	What are the ways of minimizing the electromagnetic interference?	**BTL 2**	**Understand**	**CO3**
14.	State the features of ratio transformers which make them popular for bridge applications.	**BTL 6**	**Create**	**CO3**
15.	What is an isolation amplifier? Analyze and write where is it used?	**BTL 1**	**Knowledge**	**CO3**
16.	List the various types of detectors for AC Bridges.	**BTL 1**	**Knowledge**	**CO3**
17.	Distinguish between Wheatstone bridge and Kelvin's bridge?	**BTL 3**	**Apply**	**CO3**
18.	Show the advantages of Maxwell bridge.	**BTL 1**	**Knowledge**	**CO3**
19.	Discuss the power factor and dissipation factor for Schering bridge.	**BTL 2**	**Understand**	**CO3**
20.	Analyze the Hay bridge circuit.	**BTL 3**	**Apply**	**CO3**
21.	Explain the operation of Wein bridge.	**BTL 4**	**Analyse**	**CO3**
22.	List out the types of A.C bridges.	**BTL 3**	**Apply**	**CO3**
23.	Explain the operation of Instrumentation Amplifiers.	**BTL 4**	**Analyse**	**CO3**
24.	List the Applications of Instrumentation Amplifiers	**BTL 3**	**Apply**	**CO3**

PART – B					
1.	Illustrate the Kelvin's bridge with its circuit diagram and derive its balance equation.	(16)	**BTL 4**	**Analyse**	**CO3**
2.	Validate the following in detail: (i) Maxwell bridge, (ii) Hay bridge.	(16)	**BTL 3**	**Apply**	**CO3**
3.	(i) Explain the theory and working principle of Wheat stone's Bridge. Derive the relation for finding unknown resistance. (ii) Describe any one method for the measurements of high resistance.	(8) (8)	**BTL 2** **BTL 2**	**Understand**	**CO3**
4.	Draw a neat diagram of Kelvin double bridge and explain how to measure low resistance.	(16)	**BTL5**	**Evaluate**	**CO3**
5.	Explain how the inductance is measured in terms of known Capacitance using Maxwell's bridge. Compose the conditions for balance.	(16)	**BTL 2**	**Understand**	**CO3**
6.	Examine the following bridges with neat diagram: (i) Schering bridge, (ii) Wien bridge	(16)	**BTL 2**	**Understand**	**CO3**
7.	(i) In a balanced network, AB is a resistance of 500 ohm in series with an inductor of 0.18H, BC and DA are non-inductive resistances of 1 k ohm each and CD consists of a resistance R in series with a capacitor C. A potential difference of 5 V at a frequency of $5000/2\pi$ is applied between points A and C. Determine the values of R and C. (ii) Draw and explain the balance conditions of a Wheatstone bridge.	(8) (8)	**BTL5** **BTL2**	**Evaluate** **Understand**	**CO3** **CO3**
8.	(i) Explain the construction of Anderson's bridge. Derive the unknown quantities at balance condition. Also write it's advantages and disadvantages. (ii) Derive the expressions for measurement of unknown capacitance with a neat bridge circuit.	(8) (8)	**BTL4** **BTL4**	**Analyse** **Analyse**	**CO3** **CO3**
9.	Estimate the way to measure the phase angle using ratio transformer?	(16)	**BTL1**	**Knowledge**	**CO3**
10	Explain the following AC Bridges (i) Maxwell's Bridge (ii)Anderson's Bridge.	(8) (8)	**BTL 1**	**Knowledge**	**CO3**

11.	Evaluate the expression for the current through the galvanometer in case of unbalanced Wheatstone Bridge. And also state its application.	(16)	**BTL 1**	**Knowledge**	**CO3**
12.	Explain the theory and working principle of Hay's Bridge. Derive the relation for finding unknown resistance and inductance.	(16)	**BTL 2**	**Understand**	**CO3**
13.	(i) With the help of Schering bridge, explain how loss angle of a dielectric can be determined. (ii) Explain the measurements of frequency by Wien's bridge.	(8) (8)	**BTL 2**	**Understand**	**CO3**
14.	Design the Kelvin's bridge and construct the Kelvin's double bridge from the principle of kelvin's bridge.	(16)	**BTL 2**	**Understand**	**CO3**
15.	Design the Kelvin's bridge and construct the Anderson's Bridge.	(16)	**BTL5**	**Evaluate**	**CO3**
16.	Explain the working and operation of Instrumentation Amplifiers**.**	(16)	**BTL 2**	**Understand**	**CO3**
17.	Explain the different types of Instrumentation Amplifiers**.**	(16)	**BTL 2**	**Understand**	**CO3**

UNIT IV - TRANSDUCERS FOR MEASUREMENT OF NON-ELECTRICAL PARAMETERS

Classification of transducers – Measurement of pressure, temperature, displacement, flow, angular velocity – Digital transducers – Smart Sensors.

PART – A

Q.No	Questions	BT Level	Competence	COs
1.	Define primary transducer?	**BTL 2**	**Understand**	**CO4**
2.	Quote the principle of operation of optical transducer?	**BTL 1**	**Knowledge**	**CO4**
3.	What are the factors to be considered for selection of transducers?	**BTL 3**	**Apply**	**CO4**
4.	Write the functions of transducer.	**BTL 6**	**Create**	**CO4**
5.	Classify the transducers based on working principle	**BTL 2**	**Understand**	**CO4**
6.	Mention the need of ADC and DAC in digital data acquisition system.	**BTL 1**	**Knowledge**	**CO4**
7.	Compare sensor and transducer.	**BTL 4**	**Analyse**	**CO4**
8.	In capacitive transducer, which principle exhibits linear characteristics? How?	**BTL 3**	**Apply**	**CO4**
9.	Mention the electrical phenomena used in transducers.	**BTL 1**	**Knowledge**	**CO4**
10.	What are mechanical transducer	**BTL 5**	**Evaluate**	**CO4**
11.	Classify any two applications of Smart Sensors	**BTL 3**	**Apply**	**CO4**
12.	List the elements of DAQ System.	**BTL 2**	**Understand**	**CO4**
13.	What are the two ways that the DAS are used to measure and record analog signals?	**BTL 2**	**Understand**	**CO4**
14.	Describe inverse transducers with example	**BTL 2**	**Understand**	**CO4**
15.	What is thermal imager?	**BTL 4**	**Analyse**	**CO4**
16.	Discuss in brief about LVDT	**BTL 1**	**Knowledge**	**CO4**
17.	Write the materials used for piezo electric transducer. Mention any 2- applications of it.	**BTL 2**	**Understand**	**CO4**
18.	Describe strain gauge? List its types.	**BTL 2**	**Understand**	**CO4**
19.	Explain in brief about gauge factor? Give its expression.	**BTL 1**	**Knowledge**	**CO4**
20.	Formulate the elements of data acquisition system.	**BTL 1**	**Knowledge**	**CO4**
21.	What is meant by thermal imager?	**BTL 2**	**Understand**	**CO4**
22.	Define Hall effect. Mention any 2-applications of Hall effect.	**BTL 2**	**Understand**	**CO4**

23.	What is meant by smart sensors?		**BTL 1**	**Knowledge**	**CO4**
24.	List any four applications of smart sensors.		**BTL 1**	**Knowledge**	**CO4**
	PART – B				
1.	(i) What is called piezo-electric transducer? Explain its working with neat diagram. (ii) Examine how to measure pressure using capacitive type transducer.	(8) (8)	**BTL 4**	**Analyse**	**CO4**
2.	Elaborate the types of resistive and inductive transducer used for measuring pressure.	(16)	**BTL 3**	**Apply**	**CO4**
3.	(i) Explain in brief about data acquisition system? With generalized block diagram, explain the functions of it. ii) Describe about smart sensors.	(8) (8)	**BTL 3**	**Apply**	**CO4**
4.	Tell about the features, classification and working of mechanical transducers.	(16)	**BTL 6**	**Create**	**CO4**
5.	Discuss in brief on the following. (i) Capacitive transducer. (ii) Piezo electric transducer. (iii) Resistance thermometer.	(16)	**BTL 1**	**Knowledge**	**CO4**
6.	(i) Explain how a Hall Effect transducer is used to measure electric current with a schematic representation. (ii) Describe the concept of smart sensors.	(16)	**BTL 5**	**Evaluate**	**CO4**
7.	Analyse the working of Linear Variable Differential Transformer with its advantages.	(16)	**BTL 1**	**Knowledge**	**CO4**
8.	(i) What are rosettes type strain gauges? Under which condition rosettes are used? Draw any two types of rosettes. (ii) Discuss active and passive transducers with an example briefly for each type.	(16)	**BTL 1**	**Knowledge**	**CO4**
9.	Explain the factors need to be considered for the selection of transducers.	(16)	**BTL 2**	**Understand**	**CO4**
10.	What is meant by transducer? Explain how the transducer can be classified.	(16)	**BTL 2**	**Understand**	**CO4**
11.	Describe the linear and angular measurement using capacitive transducer.	(16)	**BTL 2**	**Understand**	**CO4**
12.	Elucidate the principle of operation of optical transducers.	(16)	**BTL 6**	**Create**	**CO4**
13.	Explain in detail about hall effect transducer and mention some applications of hall effect transducer.	(16)	**BTL 3**	**Apply**	**CO4**
14.	(i) Describe in detail, the working principle of capacitive Microphone. (ii) Write a detailed technical note on smart sensors. Explain also the various built-in features of them compared to conventional sensors.	(16)	**BTL 2**	**Understand**	**CO4**
15.	Explain in detail about the components, working, types and applications of thermal imagers	(16)	**BTL 3**	**Apply**	**CO4**
16	With neat sketch explain the theory and operating principle of resistance strain gauge.	(16)	**BTL 2**	**Understand**	**CO4**

17	Evaluate the general architecture of smart sensor with block level considerations.	(16)	**BTL 3**	**Apply**	**CO4**

UNIT V - DIGITAL INSTRUMENTATION

A/D converters: types and characteristics – Sampling, Errors- Measurement of voltage, Current, frequency and phase - D/A converters: types and characteristics- DSO- Data Loggers – Basics of PLC programming and Introduction to Virtual Instrumentation -Instrument standards.

PART – A

Q.No	Questions	BT Level	Competence	COs
1.	Define primary transducer?	**BTL 1**	**Knowledge**	**CO5**
2.	Quote the principle of operation of optical transducer	**BTL 1**	**Knowledge**	**CO5**
3.	Write the functions of transducer	**BTL 1**	**Knowledge**	**CO5**
4.	Compare sensor and transducer	**BTL 1**	**Knowledge**	**CO5**
5.	Mention the need of ADC and DAC in digital data acquisition	**BTL 6**	**Create**	**CO5**
6.	Mention the electrical phenomena used in transducers	**BTL 1**	**Knowledge**	**CO5**
7.	Define piezo electric effect	**BTL 1**	**Knowledge**	**CO5**
8.	Classify any two applications of Smart Sensors	**BTL 2**	**Understand**	**CO5**
9.	List the elements of DAQ System.	**BTL 1**	**Knowledge**	**CO5**
10.	What are the two ways that the DAS are used to measure and record analog signals?	**BTL 3**	**Apply**	**CO5**
11.	Describe strain gauge? List its types	**BTL 3**	**Apply**	**CO5**
12.	Classify the functions of data logger?	**BTL 2**	**Understand**	**CO5**
13.	Which type of Frequency meter is use wide range of voltage? Why?	**BTL 2**	**Understand**	**CO5**
14.	What is meant by the term "sampling	**BTL 1**	**Knowledge**	**CO5**
15.	Define static error in measurement systems	**BTL 6**	**Create**	**CO5**
16.	List two types of dynamic errors in measurement systems.	**BTL 1**	**Knowledge**	**CO5**
17.	Name the types of systematic errors.	**BTL 1**	**Knowledge**	**CO5**
18.	Show the mathematical expression for error.	**BTL 2**	**Understand**	**CO5**
19.	Distinguish between the absolute error and relative error.	**BTL 6**	**Create**	**CO5**
20.	What is a digital storage oscilloscope (DSO)?	**BTL 3**	**Apply**	**CO5**
21.	Name two applications of a DSO	**BTL 6**	**Create**	**CO5**
22.	Name two common parameters that can be recorded using data loggers.	**BTL 1**	**Knowledge**	**CO5**
23.	Define standard.	**BTL 1**	**Knowledge**	**CO5**
24.	List the different types of standards of measurement	**BTL 2**	**Understand**	**CO5**

PART – B					
1.	Explain the working principle and characteristics of different types of A/D converters. Compare their applications	(16)	**BTL 5**	**Evaluate**	**CO5**
2.	Describe the process of sampling in A/D conversion and analyze the effects of sampling rate on the output signal quality	(16)	**BTL 4**	**Analyze**	**CO5**
3.	Discuss the significance of resolution and quantization error in A/D converters with suitable examples	(16)	**BTL 3**	**Apply**	**CO5**
4.	Illustrate different types of errors in A/D and D/A conversion processes, and suggest methods to minimize these errors.	(16)	**BTL 4**	**Analyze**	**CO5**
5.	Explain the principles and methods used for the measurement of voltage and current in AC and DC circuits	(16)	**BTL 3**	**Apply**	**CO5**
6.	Explain the working principles of different types of D/A converters	(16)	**BTL 4**	**Analyze**	**CO5**
7.	Design an experimental setup for the measurement of phase difference between two signals	(16)	**BTL 1**	**Knowledge**	**CO5**
8.	Explain the architecture and working of a digital storage oscilloscope (DSO). Highlight its advantages over analog oscilloscopes	(16)	**BTL 2**	**Understand**	**CO5**
9.	Design and construct the Digital Storage Oscilloscope to display the digital signal.	(16)	**BTL 5**	**Evaluate**	**CO5**
10.	Write short notes on: (i) Instrumental Errors, (ii) Environmental Errors.	(16)	**BTL 6**	**Create**	**CO5**
11	Describe the following in detail: (i) Gross error, (ii) Observational error, Random error	(16)	**BTL 6**	**Create**	**CO5**
12	Construct the digital frequency meter with a neat block diagram.	(16)	**BTL 4**	**Analyze**	**CO5**
13	Explain the working of a data logger and evaluate its role in monitoring and controlling industrial processes	(16)	**BTL 5**	**Evaluate**	**CO5**
14	Design a data acquisition system using a data logger and justify its implementation in a real-time scenario.	(16)	**BTL 5**	**Evaluate**	**CO5**
15	Describe the architecture of a Programmable Logic Controller (PLC) and explain its applications in automation.	(16)	**BTL 3**	**Apply**	**CO5**
16	Explain the basic concepts of virtual instrumentation and analyze its significance in modern measurement system.	(16)	**BTL 4**	**Analyze**	**CO5**
17	Formulate the following (i) Mechanical resonance type frequency meter. (ii) Electrical resonance type frequency meter.	(16)	**BTL 2**	**Understand**	**CO5**

COURSE OUTCOMES:

1. To acquire knowledge on fundamental art of measurement in engineering.
2. To understand the concepts of structural elements of various instruments.
3. Ability to the importance of bridge circuits.
4. To acquire knowledge about various transducers and their characteristics by experiments.
5. To understand the concept of digital instrumentation and virtual instrumentation by experiments.