		Category	L	T	P	Credit
22EE430	**MEASUREMENTS AND INSTRUMENTATION**	PCC	3	0	0	3

Preamble

The rapid development of new and exciting means of measurement using new technologies, the adoption of new standards give us a path way to the state of "Classic Electrical Measurements". However, knowledge of these subjects is important to understand the principles of modern measuring instruments. Instrumentation systems help to create, construct and maintain measuring devices and systems found in manufacturing plants and research institutions. Its main objective is to ensure that systems and processes operate safely and efficiently. This course is designed to impart fundamental knowledge of analog and digital measuring instruments.

Prerequisite

- Nil

Course Outcomes

On the successful completion of the course students will be able to

CO	Course Outcome Statement	TPS Scale	Expected Proficiency %	Expected Attainment %
CO1	Explain the fundamental art of measurement in Engineering	TPS2	70	75
CO2	Apply suitable analog instrument to measure the various electrical parameters (current, voltage, power and energy)	TPS3	70	70
CO3	Use potentiometers for calibration of meters	TPS3	70	70
CO4	Apply suitable DC bridge circuit to measure Resistance and suitable AC bridge circuit to measure Inductance, Capacitance and frequency.	TPS3	70	70
CO5	Apply suitable transducers for the measurement of various non-electrical parameters	TPS3	70	70
CO6	Explain the working principle of various Digital instruments.	TPS2	70	70

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	M					M	M	M		M			M	M
CO2	M	L						M		M	L		M	M
CO3	S	M	L	L				M		M	L		S	S
CO4	S	M	L	L				M		M	L		S	S
CO5	S	M	L	L				M		M	L		S	S
CO6	M	L			M		S	M		M			M	M

S- Strong; M-Medium; L-Low

Assessment Pattern:

CO	CAT 1			CAT 2			ASSIGNMENT 1				ASSIGNMENT 2				TERMINAL			
TPS SCALE	1	2	3	1	2	3	3	4	5	6	3	4	5	6	1	2	3	4
CO1	10	10													5	5		
CO2	5	20	15				50									10	10	
CO3	5	20	15				50									10	5	
CO4				5	20	15					50				5	10	10	
CO5				5	20	15					50				5	10	5	
CO6				10	10										5	5		

SYLLABUS

CONCEPTS OF MEASUREMENTS

Classification of Instruments – Elements of a generalized measurement system - Static and dynamic characteristics - Errors in measurement - Statistical evaluation of measurement data - Standards and Calibration

ANALOG INSTRUMENTS FOR MEASUREMENT OF ELECTRICAL PARAMETERS

Introduction and Classification of analog measuring instruments –Construction, operating principle and applications of : Moving coil and Moving iron meters –Dynamometer type watt meters - Single

phase Induction type Energy meter - Instrument Transformers (CT & PT) - Measurement of power in a single phase circuit using CT & PT.

POTENTIOMETERS

Basic potentiometer circuit–Multi range potentiometer- Volt-Ratio box- Applications of DC and AC potentiometers -Self balancing potentiometer.

DC & AC BRIDGES

Wheatstone bridge - cable fault location, Kelvin double bridge - Maxwell, Hay, Wien and Schering bridges and their applications - Sources of errors in bridges.

TRANSDUCERS FOR MEASUREMENT OF NON - ELECTRICAL PARAMETERS

Classification of transducers – **Temperature transducers-** RTD, thermistor, Thermocouple – **Displacement transducer -** Inductive, capacitive, LVDT, **Pressure transducer –** Bourdon tube- **Speed transducer -** Digital Encoders **– Flow transducer –** Electromagnetic flow meter .Strain gauges – Piezo electric and Hall Effect transducers- Concept of MEMS based smart sensors.

DIGITAL INSTRUMENTS

Working Principles and applications: Digital Voltmeter- Digital Multimeter - Digital Frequency Meter - Digital measurement of phase and time interval - Digital Storage Oscilloscope - Harmonic analyzer - Concept of Smart meters.

Text Books

1. H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw-Hill, New Delhi, 2010.

2. A.K. Sawhney, Puneet Sawhney 'A Course in Electrical & Electronic Measurements & Instrumentation', Dhanpat Rai and Co, New Delhi, Edition 2011.

Reference Books

1. M.M.S. Anand, 'Electronics Instruments and Instrumentation Technology', Prentice Hall India, New Delhi, 2009

2. J.J. Carr, 'Elements of Electronic Instrumentation and Measurement', Pearson Education India, New Delhi, 2011

3. R.B. Northrop, 'Introduction to Instrumentation and Measurements', Taylor & Francis, New Delhi, 3 rd Edition 2014.

4. E. O. Doebelin and D. N. Manik, "Measurement Systems – Application and Design", Tata McGraw-Hill, New Delhi, 6th Edition 2017.

5. R. K. Rajput, "Electrical and Electronics Measurements and Instrumentation", Chand Pub, 2016.

LECTURE SCHEDULE

Mo. No.	Topic	No. of Lecture Hours
1	**CONCEPTS OF MEASUREMENTS**	
1.1	Classification of Instruments – Elements of a generalized measurement system	1
1.2	Static and dynamic characteristics – Errors in measurement	2
1.3	Statistical evaluation of measurement data,	1
1.4	Standards and Calibration	1
2	**ANALOG INSTRUMENTS FOR MEASUREMENT OF ELECTRICAL PARAMETERS**	
2.1	Introduction and Classification of analog measuring instruments – moving coil and moving iron meters	2
2.2	Dynamometer type watt meters - Single phase Induction type Energy meter	2
2.3	Instrument transformers (CT & PT)- Measurement of power using CT & PT.	2
3	**POTENTIOMETERS**	
3.1	Basic potentiometer circuit–Multi range potentiometer	2
3.2	Volt-Ratio box- Applications of DC and AC potentiometers	2
3.3	Self-balancing potentiometer	1
4	**DC & AC BRIDGES**	
4.1	Wheatstone bridge, cable fault location - Kelvin double bridge	2
4.2	Maxwell, Hay, Wien and Schering bridges and their applications	3
4.3	Sources of errors in bridge circuits	1
5	**TRANSDUCERS FOR MEASUREMENT OF NON- ELECTRICAL PARAMETERS**	
5.1	Classification of transducers – **Temperature transducers-** RTD, thermistor, Thermocouple	2
5.2	**Displacement transducer –** Inductive, capacitive, LVDT	2
5.3	**Pressure transducer –** Bourdon tube-	1
5.4	**Speed transducers-** Digital Encoders	1
5.5	**Flow transducer –** Electromagnetic flow meter	1
5.6	Strain gauges Piezo electric and Hall Effect transducers	1
5.7	Concept of MEMS based smart sensors	1
6	**DIGITAL INSTRUMENTS**	
6.1	Digital Voltmeter-Digital Multimeter	2
6.2	Digital Frequency Meter – Digital measurement of phase and time interval	1
6.3	Digital Storage Oscilloscope, Harmonic analyzer	1
6.4	Concept of Smart meters.	1
	Total	**36**

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