

Branch Name:	Electrical Engineering
Program Code:	ET109
Course Name:	Electrical Measurement and Measuring Instruments
Course Code:	1ET1090302
Pre-requisite Course:	Fundamental Knowledge of Electrical Quantities & Measuring Instruments

Course Objectives:

1. Electrical Measurement & Measuring Instruments is a subject where a student will learn the generalized theory of Measurement of Various parameters (like Resistance, Inductance and Capacitance) which will help to know about measurement.
2. The major objective of the subject is to use the measuring instruments practically & to understand how different types of meter's work and their construction.
3. To make the students familiar with the impact of various A.C bridges, Meters, Instruments.

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)								
Lecture	Tutorial	Practical	Credit	Theory				Practical				Total
				University Assessment		Continuous Assessment		University Assessment		Continuous Assessment		
				Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
4	-	2	5	28	70	12	30	12	30	08	20	150

Course Contents:

Sr. No.	Topic	Total Hours	Weightage (%)
1	Philosophy of Measurement: Measurement & Methods of Measurement, Classification of an instrument, Characteristics of instruments- definitions true value, accuracy, precision, error, sensitivity and resolution, Errors in measurement & its analysis, Units and dimensions in S.I. system, measurement of absolute values of current and resistance.	07	10
2	Measurement of Parameters using Bridges: Measurement of Resistance - Measurement of low resistance using Kelvin's double bridge method, Measurement of medium resistance using Wheatstone bridge method, Measurement of high resistance using Megger. A.C Bridges - General equation for ac bridge balance, General form of an ac bridge, Sources and detectors. Measurement of Inductance - Measurement of self-inductance using Maxwell's bridge, Hay's bridge, Anderson's bridge, Owen's bridge. Measurement of capacitance- De-Sauty's bridge, Schering bridge. Measurement of frequency using Wein's bridge.	14	25
3	Analog Ammeters and Voltmeters: Analog instruments - classification of analog instruments; principle of operation, various operating forces, PMMC, Moving Iron, Moving Coil, Dynamometer type, Induction type, Thermocouple, Hot Wire, Extension of range of instruments.	11	20

4	Wattmeter & Energy meter: Electrodynamometer Wattmeter - Construction, Theory, Errors of Low power factor Wattmeter, Measurement of power in poly-phase circuits using Two wattmeter and Three wattmeter method, Measurement of Reactive power. Energy meter for A.C. circuits - single phase Induction type watt-hour meter. (Construction, theory, operation, lag adjustment, friction compensation, creep and errors), Maximum Demand indicator.	11	20
5	Electronics Instruments: Electronic Voltmeters - Differential amplifier, Differential amplifier type of Electronic Voltmeter, D.C. Voltmeter with direct coupled amplifier, Electronic voltmeters using Rectifiers. True R.M.S. reading voltmeters. Electronic Millimeters, Electronic ohmmeters, Considerations in selecting an analog voltmeter, Differential voltmeter, Vector voltmeter, A.C. Voltage measurements, Current measurements using Electronic Instruments, D.C. & A.C. current measurements, digital tachometer.	13	25

Text Books:

1. A course in Electrical & Electronic Measurement and Instrumentation, Dhapat Rai & Co. A.K.Sawhney.
2. Modern Electronic instrumentation & Measuring instruments, Wheeler Publication. -A.D. Heltric & W.C.Copper.

Reference Books:

1. Electrical Measurement & Measuring Instruments, Wheller Publication - E.W. Golding & Widdies.
2. A course in Electrical & Electronic Measurement and Instrumentation, S.K.kataria & Sons. – J.B.Gupta.

List of Experiments:

1. Measurement of Low resistance using Kelvin Double bridge.
2. Measurement of Medium resistance using Wheatstone's Bridge.
3. Measurement of Insulation resistance using Megger.
4. Extension of range of Ammeter by using Shunt.
5. Extension of range of Voltmeter by using Multiplier.
6. Measurement of Unknown Inductance by Maxwell's Bridge.
7. Measurement of Unknown Capacitance by Maxwell's Bridge.
8. Measurement of Inductance of a given coil by Anderson's Bridge.
9. To Study the Working of De Sauty's Bridge and Compare the Capacitance of Two Capacitors.
10. To Study the Working of De Sauty's Bridge and Compare the Capacitance of Two Capacitors.
11. Measurement of Capacitance by Wien's Bridge. For (a) Series Connection (b) Parallel Connection.

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Acquire the knowledge regarding measurement of various quantity and will be able to carry out various experimental studies about measurement.	1 Remembering

CLO2	Capable to measure electrical quantity like resistance, inductance, capacitance, power etc. using various measuring instruments	2 Understanding 3 Applying
CLO3	Capable to calibrate the measuring devices such as meters.	3 Applying 4 Analyze
CLO4	Know working principle, performance and applications of all bridges used for electrical measurement.	1 Remembering
CLO5	Formulate and solve the problem of electrical power measurement.	5 Evaluate
CLO6	Acquire knowledge regarding electronics measurement.	2 Understanding

Mapping of CLOs with POs & PSOs

Course Learning Outcomes	Program Outcomes (POs)												Program Specific Outcomes(PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CLO1	L				M						M				L	
CLO2			H				L	H		M		L		L		H
CLO3		M			L				M					M		L
CLO4	L		H		M							M				L
CLO5		M			L				M						M	L
CLO6				H			H	L	M		M	M	L		H	L

H: High, M: Medium, L: Low