25EEMJ206: Electrical Measurement and Measuring Instruments

w. e. f. Academic Year:	**2026-27**
Semester:	**B.E. 3rd (Electrical Engineering)**
Category of the Course:	**PCC**
Prerequisite:	Fundamental concepts of voltage, current, power, energy, and electrical quantities.
Rationale:	This subject provides fundamental knowledge of electrical and electronic measurement techniques and measuring instruments.

Course Outcomes:

After Completion of the Course, Student will able to:

	Course Outcome (CO)	**RBT Level (Cognitive Domain)**
CO1	Explain the fundamentals of measurement systems, types of errors, and characteristics of instruments.	Understand, Remember
CO2	Classify and describe various analog measuring instruments and evaluate their applications in electrical systems.	Analyze
CO3	Apply appropriate instruments and techniques to measure power and energy in AC and three-phase systems. Analyze different methods for measuring low, medium, and high resistance.	Apply, Create
CO4	Evaluate inductance, capacitance, and frequency using appropriate A.C. bridge circuits and assess accuracy.	Apply, Evaluate
CO5	Evaluate measurement data by performing error analysis and interpreting waveforms using different AC bridges. Measuring instrument considering sustainability and efficiency.	Apply / Evaluate

Teaching and Evaluation Scheme:

Teaching Scheme					**Examination Scheme**				
L	**T**	**P**	**C**	**Hrs/Week**	**IE**	**EE**	**CIA**	**Practical**	**Total Marks**
3	0	4	5	7	40	60	30	20	150

IE: Internal Exam CIA: Continuous Internal Assessment
EE: External Exam (End Semester) Practical: Practical Exam (End Semester))

Detailed Syllabus:

Unit No.	**Topic**	**Hrs**	**Marks % Weightage (Approx.)**
UNIT: 1	**Concepts of Measurements & Measurement Systems:** Introduction to measurement and instrumentation, S. I. system, methods of measurement, static and dynamic	**10**	**25**

	characteristics of instruments, definitions – true value, accuracy, error, precision, sensitivity, resolution etc. Measuring system contributing to sustainable mobility		
UNIT: 2	**Analog Electromechanical:** Classification of analog instruments, principle of operation, operating forces, errors in ammeters and voltmeters, permanent magnet moving coil, moving iron, dynamometer type, induction type, electrostatic type instruments. Electrodynamometer type wattmeter. Analysis aimed to study various types of Analog electromechanically instruments	**10**	**25**
UNIT: 3	**Power-Energy Measuring Instruments:** Introduction, measurement of power in three phase circuits, three phase wattmeter, measurement of reactive power, energy meter for A.C. circuits, induction type energy meter. Power energy measurement and enhance sustainable energy measurement	**10**	**20**
UNIT: 4	**Measurement of Resistance:** Introduction, classification of resistances, Measurement of low resistances, measurement of medium resistances & measurement high resistances, insulation resistance measurement, localization of cable fault, Loop tests. Measurement used for improving sustainability	**10**	**20**
UNIT: 5	**Measurement of Inductance and Capacitance:** Introduction, Types of bridges, A. C. bridges for inductance measurement- Maxwell, Hays, Anderson and Owen bridges, capacitance measurement – De-sauty and Schering Bridge. measurement of frequency by Wien's bridge. Measuring Study of Measurement used for inductance and capacitance systems Contributing to sustainable mobility	**5**	**10**
		45	**100**

List of Practical:

Sr. no.	Topic	Hrs
1	To Study Electrical Measuring Instruments.	4
2	Find out resistance to using Ammeter- Voltmeter method	4
3	Find out power in a 3-phase system using a 2-wattmeter method.	4
4	Find power factor in 1-phase circuit using P.F meter.	4
5	Calibration of the single phase induction type energy meter	4
6	To Extend The Range For Ammeter .	4
7	Measurement of unknown Capacitance and Inductance by Maxwell’s L/C Bridge	4
8	To Measure the Unknown Capacitance and Its Dissipation Factor Using Schering Bridge**.**	4
9	To measure the frequency of an unknown AC signal using a Wien’s Bridge.	4
10	To measure the insulation resistance of a high-voltage cable or motor winding using a Megger.	4
11	To calibrate a single-phase induction type energy meter by comparing it against a standard wattmeter and stopwatch.	4
12	To measure the reactive power in a three-phase circuit using a single wattmeter.	4

13	To measure the total active power in a three-phase balanced load using the two-wattmeter method.	4
14	To study and compare the response of Moving Iron and PMMC instruments on both DC and AC supplies.	4
15	To Extend The Range For Voltmeter.	4
		60

Learning Resources:

1. A. K. Sawhney - A course in Electrical Measurement and Measuring Instruments.
2. J. B. Gupta - A course in Electronic and Electrical measurements and Instrumentation, S. K.Kataria Publication
3. R.K.Rajput - Electrical and Electronic Measurements and Instrumentation.

Teaching Learning Method

- Lecture-based teaching-learning
- Group-teaching and learning
- Individual learning/self-study
- Inquiry-based learning
- Technology-based Learning

Course Outcomes Mapping:

CO No.	Course Outcome (CO)	POs/ PSOs Mapped	Cognitive Level (RBT)	Knowledge Category	Class Sessions (Lecture)
CO1	Explain the fundamentals of measurement systems, types of errors, and characteristics of instruments.	PO1 PO2 PSO1	Remember Understand	Conceptual	10
CO2	Classify and describe various analog measuring instruments and evaluate their applications in electrical systems.	PO2 PO4 PSO1	Analyze	Procedural	15
CO3	Apply appropriate instruments and techniques to measure power and energy in AC and three-phase systems. Analyze different methods for measuring low, medium, and high resistance.	PO3 PO6 PO7 PO8 PSO2	Evaluate / Create	Procedural	10
CO4	Evaluate inductance, capacitance, and frequency using appropriate A.C. bridge circuits and assess accuracy.	PO5 PO9 PO10 PO11 PSO2	Apply / Create	Conceptual / Procedural	5
CO5	Evaluate measurement data by performing error analysis and interpreting waveforms using different AC bridges. Measuring instrument considering	PO4 PO7, PO10, PSO2	Apply / Create	Conceptual / Procedural	5

	sustainability and efficiency.				

Mapping of COs with POs & PSOs:

CO	PO											PSO	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	1	3	0	0	0	0	0	0	0	0	0	3	0
CO2	0	3	0	2	0	0	0	0	0	0	0	3	0
CO3	0	0	1	0	0	1	2	1	0	0	0	0	3
CO4	0	0	0	0	1	0	0	0	1	2	1	0	3
CO5	0	0	0	2	0	0	2	0	0	2	0	0	3

3: High, 2: Medium, 1: Low

Sustainable Development Goals (SDG) Integration

Integrating the Sustainable Development Goals (SDGs) into the subject of Electrical Measurement and Measuring Instruments isn't just possible; it actually fits quite naturally once you connect measurement practices to real-world energy, safety, and sustainability challenges.

SDG Mapping with Course Outcomes

CO	Course Outcome	Relevant SDGs	Justification
CO1	Explain the fundamentals of measurement systems, types of errors, and characteristics of instruments.	SDG 9	Ensures reliable and efficient infrastructure through accurate measurement principles
CO2	Classify and describe various analog measuring instruments and evaluate their applications in electrical systems.	SDG 7 SDG 9	Supports energy-efficient system operation via proper instrument selection
CO3	Apply appropriate instruments and techniques to measure power and energy in AC and three-phase systems. Analyze different methods for measuring low, medium, and high resistance.	SDG 7, SDG 12	Enables fault detection, reducing energy loss and resource wastage
CO4	Evaluate inductance, capacitance, and frequency using appropriate A.C. bridge circuits and assess accuracy.	SDG 9 SDG 12	Improves system design accuracy and efficient use of materials
CO5	Evaluate measurement data by performing error analysis and interpreting waveforms using different AC bridges. Measuring instrument considering sustainability and efficiency.	SDG 7, SDG 12, SDG 13	Promotes energy optimization and environmental sustainability through data analysis