III Year II Semester	**L**	**T**	**P**	**C**
Code: 20EE6012	**3**	**0**	**0**	**3**

ELECTRICAL MEASUREMENTS & INSTRUMENTATION

Preamble: This course aims at the study of principle of operation of basic analog measuring instruments for measurement of current, voltage, power, energy. The courses introduce the principles of bridge circuits, potentiometers and gives emphasis on the concepts of instrumentation for measurement of non-electrical quantities.

Course Objectives

1. To study the working principle of different analog instruments for the measurement of voltage and current.
2. To understand the working and operating principles of various bridge circuits for the measurement of resistance, inductance, capacitance and frequency.
3. To understand the principle of operation of different power and energy measuring instruments.
4. To study the working principle and working of dc and ac potentiometers.
5. To understand the concepts of instrumentation and their applications.

Course Outcomes

1. Able to choose right type of instrument for measurement of voltage and current for ac and dc.
2. Able to select suitable bridge for measurement of electrical parameters.
3. Able to choose right type of instrument for measurement of power and energy and to calibrate energy meter by suitable method.
4. Able to standardize and understand the potentiometer.
5. Able to identify industrial applications of Instrumentation.

CO – PO & CO – PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	3	1										3	2	
CO 2	2	2		2									3	2	
CO 3	3	3			2	2							3	2	
CO 4	2		1	1									2	1	1
CO5	3	2	2		2								3	2	

1 – Weak, 2 – Moderate and 3 – Strong

Unit – I: Measuring Instruments Systems And Performance 12 Hours

Block diagram of Measurement System, Performance Characteristics, – Static characteristics – Dynamic Characteristics – Errors in Measurement. Classification of instruments – Deflecting, control and damping torques – Ammeters and Voltmeters –PMMC, MI and dynamometer type instruments – Expression for the deflecting torque and control torque — Extension of range using shunts and multiplier resistance.

Unit – II: Measurement Of Resistance, Inductance And Capacitance 12 Hours

Wheat stone's bridge and its sensitivity– Kelvin's double bridge for measuring low resistance– Loss of charge method for measurement of high resistance – Megger– Measurement of inductance – Quality Factor – Maxwell's bridge–Hay's bridge –Anderson's bridge– Measurement of capacitance and loss angle – Schering Bridge and Wien's bridge.

Unit – III: Measurement of Powerand Energy 12 Hours

Single phase and three phase dynamometer type wattmeter – LPF and UPF – Expression for deflecting and control torques, Measurement of active and reactive powers in balanced and unbalanced systems. Single phase induction type energy meter – Driving and braking torques – errors and compensations –Testing by phantom loading.

Unit – IV: Potentiometers 12 Hours

Principle of operation of potentiometer – Slide-wires DC Potentiometer – Standardization - D.C. Crompton's Potentiometer– Measurement of unknown resistance – Current – Voltage. AC Potentiometers**:** Drysdale-Tinsley Polar type and Gall-Tinsley Coordinate type – Applications.

Unit – V: Instrumentation 12 Hours

Classification of transducers, Resistance Thermometers, Thermocouples, Thermistors, Piezo-electric transducers and LVDT. Measurement of physical parameters: displacement, force and pressure. Measurement of strain-Strain gauges – Gauge Sensitivity-CRO- Measurement of phase and frequency -Lissajous patterns.

Text Books:

1. A course in Electrical and Electronic Measurements and Instrumentation, A.K. Sawhney, Dhanpatrai & Co.
2. Electronic Instrumentation–by H. S. Kalsi Tata MC-Graw–Hill Edition, 1995.
3. Electrical Measurements: Fundamentals, Concepts, Applications – by Reissland, M.U, New Age International (P) Limited, Publisher.

Reference Books:

1. Electrical Measurements - by Buckingham and Price, Prentice - Hall, 1961
2. Stuart A. Boyer, ―SCADA supervisory control and data acquisition, International Society of Automation Publication, 4th Edition, 2009.