# ELECTRICAL MEASUREMENTS AND INSTRUMENTATION

**Course Code: 15EE1113**

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**Pre-requisites:**

Network Analysis-I

**Course Outcomes:**

At the end of the Course, the Student will be able to:

**CO 1** Interpret the working principles of various electrical measuring instruments

**CO 2** Measure various AC quantities

**CO 3** Calculate resistance, inductance and capacitance using bridges

**CO 4** Define the laws of illumination and obtain methods to measure light and also understand the methods developed for measuring various magnetic quantities, and understand instrument transformers.

**CO 5** Evaluate the importance and also understand various transducers.

## UNIT-I (10 Lectures)

### MEASURING INSTRUMENTS:

Measuring Systems, Performance Characteristics, Static characteristics, Dynamic Characteristics. Errors in Measurement – Gross Errors, Systematic Errors, Statistical Analysis of Random Errors.Classification – Deflecting, Control and Damping Torques – Ammeters and Voltmeters – PMMC & MI Type Instruments – Expression for the Deflecting Torque and Control torque – Errors and Compensations, Extension of Range using Shunts and Series Resistance. Electrostatic Voltmeters, Electrometer and Attracted disc Types. Performance characteristics of various meters

## UNIT-II (10 Lectures)

### MEASUREMENT OF POWER AND ENERGY:

Single phase and Three phase Dynamometer wattmeter (LPF & UPF). Measurement of Active and Reactive Powers in Balanced and unbalanced systems. Single phase induction type energy meter- driving and braking torques-Three phase energy meter, maximum demand meter.

Types of P.F.meters-Dynamometer and Moving iron type- single and three phase meters, frequency meters-Resonance type and Weston type-Synchroscopes

## UNIT-III (10 Lectures)

### MEASUREMENT OF RESISTANCE, INDUCTANCE AND CAPACITANCE:

Principle and operation of D.C. Crompton's potentiometer – Standardization – Measurement of unknown Resistance, Current, Voltage – Sensitivity of Wheatstone's bridge, Kelvin's Double Bridge for measuring Low Resistance, Measurement of High Resistance – Loss of Charge method and Megger. Measurement of Inductance, Quality Factor - Maxwell's, Hay's & Anderson's Bridges, Measurement of Capacitance and loss angle – De Sauty's, Wien's & Schering Bridges.

## UNIT-IV (10 Lectures)

### MAGNETIC, THERMAL MEASUREMENTS AND INSTRUMENT TRANSFORMERS:

Ballistic galvanometer, Calibration of Hibbert's Magnetic Standard Flux meter, Lloyd Fischer Square for measuring Iron loss. Testing of ring and bar specimens, determination for BH curve and Hysteresis loss using CRO, x,Determination of leakage factor.

General methods of measuring temperature-electrical Resistance pyrometers-laws of resistance variation with temperature-indicators and recorders-Thermo electric pyrometers-thermo electric emf's, radiation pyrometers.

Current Transformer and Potential Transformer – Ratio and Phase angle errors – Design considerations.

## UNIT-V (10 Lectures)

### TRANSDUCERS:

Definition of transducers, Classification of transducers, Advantages of Electrical transducers, Characteristics and choice of transducers; Principle operation of Resistor, Inductor, LVDT and Capacitor Transducers; LVDT Applications, Thermistors, Thermocouples, Piezoelectric Transducers, Photovoltaic, Photo conductive cells, measurements of non-electrical quantities- Strain gauge and its principle of operation, gauge factor, torque and angular velocity.

### TEXT BOOKS:

1. E.W. Golding and F. C. Widdis, "Electrical Measurements and Measuring Instruments", 5th Edition, Wheeler Publishers, 2012.
2. D.V.S. Murthy, "Transducers and Instrumentation", PHI Learning, 2nd Edition, 2013 (24th Reprint)

### REFERENCES:

1. A.K. Sawhney, "A Course in Electrical and Electronic Measurements and Instrumentation",Dhanpatrai& Co., 19th Edition, 2011(Reprint:2016)
2. A.S Morris, "Principles of Measurement and Instrumentation" Pearson /Prentice Hall of India, 2nd Edition.
3. H.S. Kalsi, "Electronic Instrumentation", Tata McGraw-Hill, 3rd Edition, 2010.
4. A.D.Helfrick and W.D. Cooper, "Modern Electronic Instrumentation and Measurement Techniques", Pearson/ Prentice Hall of India, 14th Reprint, 2003.