ELECTRICAL MEASUREMENTS AND INSTRUMENTATION

Course Code: 13EE1114

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Pre requisites: Knowledge of Basic Network Analysis.

Course Educational Objectives:

To familiarize the students to various types of measuring instruments and their performance characteristics.

Course Outcomes:

Student is able to understand the basic principles of measuring instruments related to Electrical Engineering and choose a proper measuring instrument suitable for any given application taking into consideration the operating conditions.

UNIT-I

MEASURING INSTRUMENTS:

Measuring Systems, Performance Characteristics, Static and 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. Comparison of performance characteristics of various types of meters.

UNIT-II

MEASUREMENT OF POWER & ENERGY:

Single Phase and Three Phase Dynamometer wattmeter (LPF and 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.

Type of P.F. Meters – Dynamometer and Moving Iron Type – Single and Three Phase meters, Frequency meters – Resonance Type and Weston type – Synchroscopes.

UNIT-III

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 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

MAGNETIC , OPTICAL AND THERMAL MEASUREMENTS:

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, Determination of leakage factor.

Illumination-Definitions, Laws of Illumination, measurement of luminous intensity. 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.

UNIT-V

INSTRUMENT TRANSFORMERS AND TRANSDUCERS:

Current Transformer and Potential Transformer – Ratio and Phase angle errors – Design considerations .Definition of transducers, Classification of transducers, Advantages of Electrical transducers, Characteristics and choice of transducers; Principle operation of Resistive Transducers, Inductive Transducers, LVDT and Capacitive 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, measurement of torque and angular velocity.

TEXT BOOKS:

1. E.W. Golding and F. C. Widdis, *"Electrical Measurements and Measuring Instruments"*, 5th Edition, Reem Publications,2011. [Unit-1,2,3,4]
2. A. K. Sawhney, *"A course in Electrical and Electronic Measurements and Instrumentation"*, Dhanpatrai & Co., 18th Edition, 2008.[Unit-5]

REFERENCES:

1. A.S Morris, *"Measurement and Instrumentation Principles"*, Elsevier, 3rd Edition,2006.
2. H.S. Kalsi, *"Electronic Instrumentation"*, Tata McGraw-Hill 3rd Edition, 2010.