

EEPC2004 ELECTRICAL MEASUREMENT AND INSTRUMENTATION (3-0-0)

Module I (8 Hours)

Measurement and Error: Definition, Accuracy and Precision, Significant Figures, Types of Errors. Standards of Measurement: Classification of Standards, Electrical Standards, IEEE Standards.

Measuring instruments: Absolute and secondary instrument, indicating and recording instrument.

Types Of Measuring Instrument: Ammeter and Voltmeter: Derivation for Deflecting Torque of; PMMC, MI (Attraction and Repulsion Types), Electro Dynamometer and Induction Type Ammeters and Voltmeters. Energy Meters and Wattmeter. Construction, Theory and Principle of Operation of Electro-Dynamometer and Induction Type Wattmeter, Compensation, Creep, Error, Testing, Single Phase and Polyphase Induction Type Watt-Hour Meters. Frequency Meters: Vibrating Reed Type, Electrical Resonance Type, Power Factor Meters.

Module II (8 Hours)

Measurement of Resistance, Inductance And Capacitance:

Resistance: Measurement of Low Resistance by Kelvin's Double Bridge, Measurement of Medium Resistance, Measurement of High Resistance, Portable Resistance Testing Set (Megohmmeter), Measurement of Resistance of Earth Connections.

Inductance: Measurement of Self Inductance by Ammeter And Voltmeter, and AC Bridges (Maxwell's, Hay's, & Anderson Bridge), Measurement of Mutual Inductance by Felici's Method, and as Self Inductance. Capacitance: Measurement of Capacitance by Ammeter and Voltmeter, and AC Bridges (Owen's, Schering & Wien's Bridge), Screening of Bridge Components and Wagner Earthing Device.

Transducer: Strain Gauges, Thermistors, Thermocouples, Linear Variable Differential Transformer

(LVDT), Capacitive Transducers, Piezo-Electric transducers, Optical Transducer, Hall Effect Transducer.

Module III (6 Hours)

Galvanometer: Construction, Theory and Principle of Operation of D'Arsonval, Vibration (Moving Magnet & Moving Coil Types), and Ballistic Galvanometer, Influence of Resistance on Damping, Logarithmic Decrement, Calibration of Galvanometers, Galvanometer Constants.

Potentiometer: Construction, Theory and Principle of Operation of DC Potentiometers (Crompton, Vernier, Constant Resistance, & Deflection Potentiometer), and AC Potentiometers (Drysdale-Tinsley & Gall-Tinsley Potentiometer).

Module IV (6 Hours)

Instrument Transformers: Potential and current transformers, ratio and phase angle errors, phasor diagram, methods of minimizing errors.

Electronic Instruments for Measuring Basic Parameters: Amplified DC Meters, AC Voltmeters Using Rectifiers, True RMS Voltmeter, Digital Multi-meter & Digital Frequency meter: (Block diagram, principle of operation)

Module V (2 Hours)

Oscilloscope: Block Diagrams, Delay Line, Multiple Trace, Oscilloscope Probes, Oscilloscope Techniques, Introduction to Analog and Digital Storage Oscilloscopes, Measurement of Frequency, Phase Angle, and Time Delay Using Oscilloscope.

Course Outcomes: On completion of this course, students are able to:

- CO1: Explain the fundamentals of measurement, error analysis, and standards in electrical measurements.
- CO2: Classify and evaluate various types of measuring instruments, including ammeters, voltmeters, energy meters, wattmeters, and frequency meters, understanding their principles and error sources.
- CO3: Measure electrical quantities such as resistance, inductance, and capacitance using suitable methods and AC bridge techniques.
- CO4: Illustrate the principles, construction, and operation of transducers like strain gauges, thermistors, thermocouples, and other sensing devices.
- CO5: Apply the principles of operation and calibration of galvanometers and potentiometers for precise electrical measurement.
- CO6: Evaluate instrument transformers, such as potential and current transformers, analyzing errors and correcting them.
- CO7: Operate and interpret readings from electronic measuring instruments, such as digital multimeters and oscilloscopes, for frequency, phase, and time-delay measurements.

Text Book(s):

1. A Course in Electrical and Electronic Measurements and Instrumentation – A K Sawhney – Dhanpat Rai & Co.
2. Modern Electronic Instrumentation and Measurement Techniques – Helfrick & Cooper – Pearson Education.

Reference Book(s):

1. Electrical Measurements and Measuring Instruments – Golding & Widdis – 5th Edition, Reem Publication.
2. Electronic Instrumentation – H C Kalsi – 2nd Edition, Tata Mcgraw Hill
3. Electronic Measurement and Instrumentation – Oliver & Cage – Tata Mcgraw Hill