

16EE305 ELECTRICAL MEASUREMENTS AND INSTRUMENTATION

Hours Per Week :

L	T	P	C
2	-	2	3

Total Hours :

L	T	P	WA/RA	SSH/HSB	CS	SA	S	BS
30	-	30	5	40	-	8	5	-

Course Description and Objectives:

This course provides adequate knowledge of various instruments for measuring electrical quantities. The objective of course is to understand basic laws governing the operation and working of instruments and their equivalent circuits used for the measurement of voltage, current, power, energy, frequency and phase angle.

Course Outcomes:

The student will be able to:

- differentiate PMMC and MI instruments.
- measure frequency using oscilloscope.
- determine R, L and C of the given impedances using different bridges.
- understand the functioning and use of digital instruments.

SKILLS:

- ü *Select appropriate instrument for measuring given quantity.*
- ü *Extend the range of ammeter and voltmeter.*
- ü *Calculate the energy consumed by domestic load.*
- ü *Design Kelvin's double bridge and determine the unknown resistance.*
- ü *Design Maxwell Bridge and determine the unknown impedance.*
- ü *Design Hay's Bridge and determine the unknown impedance.*

UNIT - 1

L-7

ANALOG ELECTROMECHANICAL INSTRUMENTS: Introduction to measurements, Classification of instruments, Different torques (Deflecting, Control and damping), Construction and working principle, Torque equation, PMMC, Moving iron instruments, Extension of range using shunt and multiplier (elementary treatment).

INSTRUMENT TRANSFORMERS: Need for instrument transformers, CT and PT, Ratio and phase angle errors (Definition and phasor diagram only).

UNIT - 2

L-6

MEASUREMENT OF POWER AND ENERGY: Construction and working principle of single phase dynamometer wattmeter - LPF and UPF wattmeter, Errors and compensations; Extension of range of wattmeter using instrument transformer (preliminary discussion), Measurement of active and reactive power in 3 phase circuit, Construction and working principle of single phase induction type energy meter, Errors and compensations, Phantom loading.

UNIT - 3

L-6

MEASUREMENT OF RESISTANCE, INDUCTANCE AND CAPACITANCE : Classification of resistance, Methods of measuring low, Medium and high resistance, Carey Foster's bridge, Kelvin's double bridge, Loss of charge method, DC Crompton's potentiometer, Measurement of inductance - Quality Factor, Maxwell's bridge; Measurement of capacitance and loss angle - Desauty bridge, Wien's bridge.

UNIT - 4

L-5

INTRODUCTION TO DIGITAL INSTRUMENTATION : Digital instruments, Principle of operation of DVMs, Display devices LEDs and LCDs, Oscilloscope - Basic block diagram, Measurement of phase and frequency, Lissajous pattern; Resonance and Weston type frequency meter.

UNIT - 5

L-6

TRANSDUCERS : Definition of transducers, Classification of transducers, Characteristics of transducers, Principle and operation of LVDT and its applications.

LABORATORY EXPERIMENTS

LIST OF EXPERIMENTS

Total hours: 30

1. Calculation of unknown impedance by using Anderson's bridge.
2. Calculation of unknown resistance by using Kelvin's double bridge.
3. Calculation of unknown capacitance by using Schering bridge.
4. Measurement of choke coil parameters.
5. Estimation of ratio error in case of current transformer.
6. Estimation of ratio error in case of potential transformer.
7. Phantom loading
8. LPF wattmeter
9. Measurement of 3 phase active/ reactive power.
10. DC Crompton's potentiometer.

TEXT BOOKS:

1. E.W. Golding and F.C. Widdis, "Electrical Measurements and measuring Instruments", 5th edition, Wheeler Publishing, 1999.
2. A.K.Sawhney and Puneet Sawhney, "Electrical & Electronic Measurement & Instruments" 18th edition, Dhanpat Rai & Co., Pvt. Ltd., 2010.

REFERENCE BOOKS:

1. Reissland, M.U, "Electrical Measurements: Fundamentals, Concepts, Applications" 1st ed., New Age International (P) Ltd. Publishers, 2010.
2. J.B. Gupta, "Electronic and Electrical Measurements and Instrumentation", 12th edition, S.K. Katharia, 2006.
3. Helfrick and Cooper, "Modern Electronic Instrumentation and Measurement Techniques".

ACTIVITIES:

- Calculate meter constant for house-hold energy meter.
- Extend the range of ammeter by shunt.
- Extend the range of voltmeter by multiplier.
- Determine 3 phase active power consumed by any specific outlet in VFSTRU.
- Determine 3 phase reactive power consumed by agricultural load.
- Measurement of earth resistance using megger.