2/4 B.Tech. SECOND SEMESTER

EE4T2 ELECTRICAL MEASUREMENTS & INSTRUMENTATION
Credits: 4

Lecture: 4 periods/week **Internal assessment: 30 marks**

Tutorial: 1 period /week **Semester end examination: 70 marks-**

Objective:
This course introduces principle of operation of basic analog and digital measuring instruments for measurement of current, voltage, power, energy etc. Measurement of resistance, inductance and capacitance by using bridge circuits will be discussed in detail. It is expected that student will be thorough with various measuring techniques that are required for an electrical engineer.

Learning outcomes :

1. The students will be familiar with various measuring instruments used to detect electrical quantities .
2. Able to design and test instrument transformers for various electrical applications
3. Understand and use measuring transducer for the most common physical quantities.

UNIT-I Measuring Instruments:
Classification – deflecting, control and damping torques – Ammeters and Voltmeters – PMMC, moving iron type instruments – expression for the deflecting torque and control torque – Errors and compensations. Extension of range using shunts and series resistance.

UNIT –II Instrument transformers:
Current Transformers – Theory, Ratio error and phase angle errors, Reduction of errors, construction of C.T, effect of Secondary open circuit, permanent magnetization and demagnetization of cores, testing of Current Transformers.
Potential Transformers - Theory, Ratio error and phase angle errors, Reduction of errors, Construction of P.T, testing of Potential Transformers.

UNIT –III Measurement of Power and Energy :
Single phase and three phase dynamometer wattmeter, LPF and UPF, expression for deflecting and control torques – Extension of range of wattmeter using instrument transformers – 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 using R.S.S. meter. Three phase energy meter – trivector meter, maximum demand meters.

UNIT – IV Special Meters and Potentiometers:
Type of P.F meters – Single phase Electrodynamometer Power Factor meter, three phase Electrodynamometer Power Factor meter, and Moving Iron Power Factor meters.
Type of Frequency meters – Mechanical Resonance type Frequency meter, Electrical Resonance type Frequency meter, Weston type Frequency meter, Ratiometer type Frequency meter, Saturable core Frequency meter.
Synchroscopes – Electrodynamometer type Synchroscopes, Moving Iron Synchroscopes. Phase sequence Indicators.
Principle and operation of D.C. Crompton's potentiometer – standardization – Measurement of unknown resistance, current, voltage. A.C. Potentiometers: polar and coordinate types - standardization – applications.

UNIT – V Resistance Measurements:
Method of measuring low, medium and high resistance – sensitivity of Wheatstone's bridge – Carey Foster's bridge- Kelvin's double bridge for measuring low resistance– loss of charge method for measurement of high resistance.

UNIT –VI A.C. Bridges:
Measurement of inductance, Quality Factor - Maxwell's bridge, Hay's bridge, Anderson's bridge, Owen's bridge. Measurement of capacitance and loss angle - Desauty bridge-Wien's bridge – Schering Bridge.

UNIT – VII Transducers:
Principles of transducers, Resistance Thermometers, Thermistors, Thermo couples, Strain Gauge and Linear Variable Differential Transformers.

UNIT – VIII
Digital Voltmeters-Successive approximation, ramp and integrating type, Digital frequency meter and Digital tachometer- scheme of phase angle measurement unit (PMU).

TEXT BOOKS:
1. Electrical & Electronic Measurement & Instruments by A.K.Sawhney Dhanpat Rai & Co. Publications.
2.Electrical Measurements and measuring Instruments – by E.W. Golding and F.C. Widdis, fifth Edition, Wheeler Publishing
3. Modern Electronic Instrumentation and Measurement Techniques – A.D. Helfrick and W.D. Cooper, PHI, 5th Edition, 2002.

REFERENCE BOOKS:
1. Electrical Measurements – by Buckingham and Price, Prentice – Hall
2. Electrical Measurements by Harris.
3. Electrical Measurements: Fundamentals, Concepts, Applications – by Reissland, M.U, NewAge International (P) Limited, Publishers.
4. Electrical and Electronic Measurements –by G.K.Banerjee, PHI Learning Private Ltd, New Delhi-2012