

**MEASUREMENTS AND INSTRUMENTATION****B Tech II Year II Sem**

| Course Code         | Category          | Hours/<br>Week            |   |   | Credits | Maximum Marks    |     |       |
|---------------------|-------------------|---------------------------|---|---|---------|------------------|-----|-------|
| 23EE402             | Professional Core | L                         | T | P | 3       | CIE              | SEE | TOTAL |
|                     |                   | 3                         | 0 | 0 |         | 40               | 60  | 100   |
| Contact Classes: 48 | Tutorial Classes: | Practical Classes:<br>Nil |   |   |         | Total Classes:48 |     |       |

**Prerequisites:** Electrical Circuit Analysis-1 & Electrical Circuit Analysis-2, Analog Electronics Electro Magnetic Fields.

**Course Objectives:**

1. To introduce the basic principles of all measuring instruments.
2. To deal with the measurement of voltage, current, Power factor, power, energy and magnetic measurements.
3. To understand the basic concepts of smart and digital metering.

**Course Outcomes:** After learning the contents of this paper the student must be able to

1. Understand different types of measuring instruments, their construction, operation and characteristics and identify the instruments suitable for typical measurements.
2. Apply the knowledge about transducers and instrument transformers to use them effectively.
3. Apply the knowledge of smart and digital metering for industrial applications.

| Course Outcomes | Program Outcomes |     |     |     |     |     |     |     |     |      |      |      |
|-----------------|------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
|                 | P01              | P02 | P03 | P04 | P05 | P06 | P07 | P08 | P09 | P010 | P011 | P012 |
| CO1             | 3                | 1   | 1   |     |     |     |     |     |     |      |      | 2    |
| CO2             | 3                | 2   | 1   | 1   |     |     |     |     |     |      |      | 2    |
| CO3             | 3                | 2   | 1   | 1   |     |     |     |     |     |      |      | 2    |
| CO4             | 3                | 2   | 1   | 1   |     |     |     |     |     |      |      | 2    |
| CO5             | 3                | 2   | 1   | 1   |     |     |     |     |     |      |      | 2    |

**UNIT-I**

**INTRODUCTION TO 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. Electrostatic Voltmeters-electrometer type and attracted disc type – extension of range of E.S.Voltmeters.

**UNIT-II**

**POTENTIOMETERS & INSTRUMENT TRANSFORMERS:** Principle and operation of D.C. Crompton's potentiometer – standardization– Measurement of unknown resistance, current, voltage A.C. Potentiometers: polar and coordinate type's standardization – applications. CT and PT – Ratio and phase angle errors

**UNIT-III**

**MEASUREMENT OF POWER & ENERGY:** Single phase dynamometer wattmeter, LPF and UPF, Double element and three element dynamometer wattmeter, expression for deflecting and control torques– Extension of range of wattmeter using instrument transformers–Measurement of active and reactive powers Inbalanced 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 –tri-vector meter, maximum demand meters.

**UNIT-IV**

**DC & AC BRIDGES:** Method of measuring low, medium and high resistance – sensitivity of Wheat-stone's bridge–CareyFoster's bridge, Kelvin's double bridge for measuring low resistance, measurement of high resistance –loss of charge method.

Measurement of inductance- Maxwell's bridge, Hay's bridge, Anderson's bridge – Desauty's Bridge -Wien's bridge–Schering Bridge.

**UNIT-V**

**TRANSDUCERS:** Definition of transducers, Classification of transducers, Advantages of Electrical transducers, Characteristics and choice of transducers; Principle operation of LVDT and capacitor transducers; LVDT Applications, Strain gauge and its principle of operation, gauge factor, Thermistors, Thermocouples, Piezoelectric transducers, photovoltaic, photoconductive cells, and photodiodes.

**INTRODUCTION TO SMART AND DIGITAL METERING:** Digital Multi-meter, True RMS meters, Clamp- on meters, Digital Energy Meter, Cathode Ray Oscilloscope, Digital Storage Oscilloscope.

**TEXTBOOKS:**

1. A.K.Sawhney ,“Electrical & Electronic Measurement & Instruments”, Dhanpat Rai &Co. Publications,2005.
2. Dr.Rajendra Prasad, “Electrical Measurements & Measuring Instruments”, Khanna Publishers1989.

**REFERENCEBOOKS:**

1. G.K.Banerjee ,“Electrical and Electronic Measurements”, PHI Learning Pvt. Ltd., 2<sup>nd</sup> Edition, 2016.
2. R.K.Rajput, “Electrical & Electronic Measurement & Instrumentation”, S.Chandand Company Ltd., 2007.
3. S.C.Bhargava, “Electrical Measuring Instruments and Measurements”, BS Publications, 2012.
4. Bucking hamand Price, “ElectricalMeasurements”, Prentice–Hall,1988.

5. Reissland, M. U, "Electrical Measurements: Fundamentals, Concepts, Applications", New Age International(P) Limited Publishers, 1<sup>st</sup> Edition 2010.
6. E.W.Golding and F.C.Widdis, "Electrical Measurements and measuring Instruments", fifth Edition, Wheeler Publishing, 2011.