# ELECTRICAL MEASUREMENTS AND INSTRUMENTATION LABORATORY

**IV Semester: EEE**

| Course Code | Category | Hours / Week | | | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | C | CIA | SEE | Total |
| AEE107 | Core | - | - | 3 | 2 | 30 | 70 | 100 |
| Contact Classes: Nil | Tutorial Classes: Nil | Practical Classes: 42 | | | | Total Classes: 42 | | |

## I. COURSE OVERVIEW:

The objective of this laboratory course is to learn about the electrical measurement methods, operational principles with suitable software and hardware. It provides an opportunity for the students to identify and calibrate the various electrical instruments for obtaining errors. The lab emphasizes on the practical skills to design and realize the use of instruments for different electrical applications.

## II. OBJECTIVES:

**The course should enable the students to:**

I The calibration and testing methods of different electrical measuring instruments used for the measurement of voltage, current, power, energy.

II The different transducers for measurement of physical quantities like pressure,temperature, level.

III The simulation models in Lab view to measure passive electrical parameters.

## III. COURSE OUTCOMES:

**After successful completion of the course, students should be able to:**

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| CO 1 | **Make use of** transducers like thermocouple, thermistorand resistance temperature detector for measuring temperature. | Apply |
| CO 2 | **Choose** appropriate transducers for the measurement of strain,pressure, position and level. | Apply |
| CO 3 | **Examine** the errors in measuring instrument by calibrating voltmeter,ammeter, LPF wattmeter, single phase energy meter, dynamometer power factor meter. | Analyze |
| CO 4 | **Develop** Lab view programs for displaying electrical waveforms and Lissajous patterns. | Analyze |
| CO 5 | **Build** simulation models in digital environment for the measurement of passive parameters like inductance, capacitance and resistance. | Apply |
| CO 6 | **Analyze** the quantities like turns ratio, reactive power, errors associated with current transformer for reducing the errors in measuring instruments. | Analyze |

## IV. SYLLABUS:

### LIST OF EXPERIMENTS

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| **Expt. 1** | **SENSING OF TEMPERATURE AND SPEED** |

Measurement of temperature using transducers like thermocouple, thermistors and resistance temperature detector with signal conditioning; speed measurement using proximity sensor.

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| **Expt. 2** | **CALCULATION OF DISTANCE AND LEVEL** |

Distance measurement using ultrasonic transducer; measurement of level using capacitive transducer.

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| **Expt. 3** | **MEASUREMENT OF STRAIN AND PRESSURE** |

Strain measurement using strain gauge; measurement of pressure using differential pressure transducer.

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| **Expt. 4** | **MEASUREMENT OF POSITION AND LINEAR DISPLACEMENT** |
| Measurement of position using encoders; measurement of linear displacement using Linear Voltage Differential Transformer (LVDT). | |
| **Expt. 5** | **PHANTOM LOADING ON LPF WATTMETER** |
| Calibration of electrodynamometer type LPF wattmeter using phantom loading | |
| **Expt. 6** | **CALIBRATION OF SINGLE PHASE ENERGY METER AND POWER FACTOR METER** |
| Calibration of single phase energy meter using resistive load and dynamometer power factor meter. | |
| **Expt. 7** | **MEASUREMENT OF TURNS RATIO AND APPLICATIONS OF CTs** |
| Measurement of turns ratio using AC bridge; the extension of range of wattmeter to measure three phase power using two CTs and one single phase wattmeter. | |
| **Expt. 8** | **MEASUREMENT OF REACTIVE POWER** |
| Measurement of reactive power using one single phase wattmeter. | |
| **Expt. 9** | **NET METERING** |
| Study of bidirectional energy measurement using net metering | |
| **Expt. 10** | **MEASUREMENT OF FREQUENCY AND THD USING DIGITAL SIMULATION** |
| Determination of frequency and Total Harmonic Distortion (THD) using LabVIEW | |
| **Expt. 11** | **ANALYSIS OF WAVE FORMS USING DIGITAL SIMULATION** |
| Measurement and display of voltage, current wave forms and analysis using LabVIEW. | |
| **Expt. 12** | **TWO WATTMETER METHOD USING DIGITAL SIMULATION** |
| Measurement of real and reactive powers using two wattmeter method and verification with LabVIEW. | |
| **Expt. 13** | **WORKING OF STATIC ENERGY METER USING DIGITAL SIMULATION** |
| Measurement of energy using static energy meter and verification with LabVIEW. | |
| **Expt. 14** | **MEASUREMENT OF PASSIVE PARAMETERS USING DIGITAL SIMULATION** |
| Resistance measurement using Kelvin's double bridge, inductance measurement using Anderson bridge and capacitance measurement using Schering bridge and verification with LabVIEW. | |

**Reference Books:**


1. https://www.bookpump.com/bwp/pdf-b/2335004b.pdf.
2. https://www.books.google.co.in › Technology & Engineering › Sensors
3. https://www.bambang.lecturer.pens.ac.id/rekayasa%20sensor%20aktuator/Sensors%20&%20Trans...
4. https://www.sae.org/images/books/toc_pdfs/BELS036.pdf
5. https://www.Gupta, Gupta & John, "Virtual Instrumentation Using Labview", Tata McGraw-Hill, 1st Edition, 2005.


**Web References:**

1. https://www.gnindia.dronacharya.info/EEEDept/Downloads/Labmanuals/EMI_Lab.pdf
2. https://www.scribd.com/doc/25086994/electrical-measurements-lab

**Course Home Page:**

**SOFTWARE AND HARDWARE REQUIREMENTS FOR A BATCH OF 36 STUDENTS:**

**SOFTWARE:** MATLAB R2015a and LabVIEW

**HARDWARE:** Desktop Computers (04 nos)

## LIST OF EQUIPMENT REQUIRED FOR A BATCH OF 36 STUDENTS:

| S. No | Name of the Equipment | Range |
|---|---|---|
| 1 | Watt meters | 300 / 600V, 10 / 20A UPF |
| 2 | Watt meters | 150 / 300V, 5 / 10A LPF |
| 3 | Power factor meter | 150 / 300V, 5 / 10A |
| 4 | Analog energy meter | 1-Phase , 10A |
| 5 | Current Transformer | 20A / 5A |
| 6 | Resistive load, | 5KW / 20A |
| 7 | Three Phase Inductive load | 5A |
| 8 | Voltmeters MI | 0-150 / 300 V |
| 9 | Voltmeters MI | 0-300 / 600 V |
| 10 | Ammeters MI | 10 / 20A |
| 11 | Turns Ratio kit | 01 No. |
| 12 | Strain gauge Kit | 01 No. |
| 13 | LVDT Kit | 01 No. |
| 14 | Transducers | 06 No. |
| 15 | Encoder | 01 No. |