Lok Jagruti Kendra University
University with a Difference

# Diploma in Electronics & Communication Engineering

LJ Polytechnic

## Course Code: 025030402
## Instrumentation & Measurement

| Programme / Branch Name | | | Diploma in Electronics and Communication Engineering | | | |
|---|---|---|---|---|---|---|
| **Course Name** | Instrumentation & Measurement | | | | **Course Code** | 025030402 |
| **Course Type** | HSSC | BSC | ESC | PCC | OEC | PEC |

**Legends:** HSSC: Humanities and Social Sciences Courses BSC: Basic Science Courses
ESC: Engineering Science Courses PCC: Program Core Courses
OEC: Open Elective Courses PEC: Program Elective Courses

## 1. Teaching and Evaluation Scheme

| Teaching Hours / Week / Credits | | | | Evaluation Scheme | | | |
|---|---|---|---|---|---|---|---|
| **L** | **T** | **P** | **Total Credit** | **CCE** | **SEE (Th)** | **SEE (Pr)** | **Total** |
| 3 | 0 | 2 | 4 | 50 | 50 | 50 | 150 |

**Legends:**
L: Lectures T: Tutorial P: Practical
CCE: Continuous & Comprehensive Evaluation
SEE (Th): Semester End Evaluation (Theory)
SEE (Pr): Semester End Evaluation (Practical)

## 2. Prerequisite

- ✓ Physics and Mathematics (Pre-university level)
- ✓ Measure basic electrical quantities/parameters/formulas/basic terms
- ✓ Some basic ideas to draw diagram using various components & Instruments
- ✓ Use major electrical instrument/equipment

## 3. Rationale

In the study of this course, the students will understand and learn the construction, working, characteristics and applications of various types of components such as voltmeter, ammeter and wattmeter which are the common instruments to measure quantities. Instrumentation are a core subject for the knowledge of which is essential for electrical engineering diploma holders and they need to assimilate it to succeed in the industry. In this regard, the basic knowledge of various types of instruments, bridges, electromechanical instruments and transducers is essential. The knowledge of this core subject is essential for comprehending the courses that will be introduced later in the diploma program as well as developing requisite skills for effective functioning in the industry.

## 4. Objectives

- ✓ Analyze various instruments such as moving iron, PMMC, and dynamometer type instruments.
- ✓ Analyze electrical instruments for measurement of voltage, current, power, power factor and frequency.
- ✓ It will develop potential to measure & analysis of such instruments for the application in domestic and industrial areas.

## 5. Contents

| Unit No. | Topics | Sub-Topics | Learning Outcome | % Weightage | Hours |
|---|---|---|---|---|---|
| 1 | **Fundamentals of Measurement and Instrumentation** | 1.1. Methods of measurement- direct and indirect methods<br>1.2. Types of instruments- Indicating, integrating, recording, absolute and secondary instruments<br>1.3. Deflecting, controlling, and damping torques<br>1.4. Accuracy, sensitivity, repeatability, range, precision, drift, hysteresis etc.<br>1.5. Types and sources of errors and its classification- gross, systematic and random error | • Direct and Indirect Measurement<br>• Indicating, Integrating, recording, absolute and secondary instruments<br>• Important torques in measurement system such as deflecting, controlling and damping torques<br>• Different terms related to measurement of instruments<br>• Types of errors and its discrimination with basic examples | 10 | 03 |
| 2 | **Electromechanical Instruments** | 2.1 Moving iron instruments-attraction and repulsion type, ammeter and voltmeter<br>2.2 PMMC instruments and vibration galvanometer, ammeter and voltmeter<br>2.3 Electrodynamometer type instruments- ammeter, voltmeter and wattmeter, power factor meter<br>2.4 Hot wire instruments<br>2.5 Measurement of energy and industrial metering<br>2.6 Induction type and solid-state energy meter<br>2.7 Extension of range using multipliers and shunt and equation derivation | • Attraction and repulsion type instruments and its differentiation<br>• Difference between PMMC and MI instruments<br>• Working principle of electrodynamometer type instruments<br>• Working of hot wire instruments<br>• Different types of industrial meter such as maximum demand indicator, tri vector meter and induction and solid type energy meter<br>• Illustration for use of shunt and multipliers for range extension in voltmeter and ammeter | 30 | 12 |

| | | | | | |
|---|---|---|---|---|---|
| 3 | **Measurement of Resistance, Inductance, Capacitance and Frequency using Bridges** | 3.1 Classification of resistance- low, medium and high<br>3.2 Kelvin's double bridge<br>3.3 Measurement or medium resistance by Wheatstone bridge, Ammeter-Voltmeter method and Ohmmeter<br>3.4 High resistance and earth resistance measurement by megger and earth tester respectively<br>3.5 Measurement of Inductance by maxwell, Anderson, hays, Owen's bridge and for Capacitance by Schering, Wein's and Desauty bridge | • Classify different types of Resistance<br>• Explain the procedure to measure low resistance by kelvin's double bridge method<br>• Explain the procedure to measure medium resistance by Wheatstone bridge method<br>• Justify and analyze the need and working of megger and earth tester<br>• A.C. bridges for measurement of inductance, capacitance and frequency | 20 | 12 |
| 4 | **Calibration & Instrument transformers** | 4.1 Calibration with it importance<br>4.2 Calibration of ammeter, voltmeter, wattmeter and single-phase energy meter<br>4.3 Classification of instrument transformers<br>4.4 Current transformer<br>4.5 Potential transformer | • Need of calibration<br>• Procedure for calibration using sub-standard meter<br>• Basic meaning of instrument transformer and its applications<br>• Classification<br>• Theory, characteristics of CT, burden, errors and its reduction<br>• Clamp on ammeter<br>• Theory, characteristics of PT, errors and its reduction<br>• Difference between CT and PT | 10 | 03 |

| | | | | | |
|---|---|---|---|---|---|
| 5 | **Transducers** | 5.1 Classify different types of transducers<br>5.2 Describe construction and working principle of different electrical transducers<br>5.3 Describe working principle of different opto-electrical transducers | • Basic meaning of transducers<br>• Classification of transducers on the basis of electrical principle, input and output signals, application etc.<br>• Resistive, inductive and capacitive transducer<br>• LVDT, RVDT<br>• Piezoelectric and Thermoelectric transducers<br>• Optoelectronic transducer – photo emissive, conductive and voltaic cell, photo diode and transistor and optocoupler<br>• Applications | 30 | 12 |
| | | | | **Total Hours** | **42** |

## 6. List of Practical's / Exercises

The practical/exercises should be properly designed and implemented in an attempt to develop different types of skills that students can acquire the competencies/programme outcomes. Following is the list of practical exercises for guidance.

| Sr. No | Practical / Exercises | Key Competency | Hours |
|---|---|---|---|
| 1 | To study about measurement and measuring instruments | Introduction of various instruments | 2 |
| 2 | Measurement of resistance by whetstone bridge method | whetstone bridge | 2 |
| 3 | To study about electromechanically instrument | Electromechanical instrument | 2 |
| 4 | To study about extension of range of ammeter | Use of ammeter | 2 |
| 5 | To study about extension of range of D.C. voltmeter | Use of Voltmeter | 2 |
| 6 | Measurement of current of AC circuit with the help of clip-on meter | Clip-on meter function | 2 |
| 7 | Use of megger for finding resistance of insulation winding | Working of megger | 2 |
| 8 | To calibrate the D.C. ammeter | Need of Calibration with ammeter | 2 |

| | | | |
|---|---|---|---|
| 9 | To calibrate the D.C. voltmeter | Need of Calibration with voltmeter | 2 |
| 10 | Calibration of single-phase energy meter | Single phase energy meter | 2 |
| 11 | To measure power in three phase circuit by 2-watt meter method | Application of 2-wattmeter method | 2 |
| | | **Total Hours** | 22 |

## 7. Suggested Specification Table with Hours

| Unit No. | Chapter Name | Teaching Hours | Distribution of Topics According to Bloom's Taxonomy | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | R % | U % | App % | C % | E % | An % |
| 1 | **Fundamentals of Measurement and Instrumentation** | 03 | 40 | 20 | 20 | 0 | 10 | 10 |
| 2 | **Electromechanical Instruments** | 12 | 20 | 20 | 15 | 20 | 20 | 5 |
| 3 | **Measurement of Resistance, Inductance, Capacitance and Frequency using Bridges** | 12 | 20 | 20 | 20 | 15 | 10 | 15 |
| 4 | **Calibration & Instrument transformers** | 03 | 20 | 20 | 15 | 20 | 10 | 15 |
| 5 | **Transducers** | 12 | 30 | 20 | 20 | 10 | 10 | 10 |

**Legends:** R-Remembering C- Creating
U- Understanding E- Evaluating
App- Applying An- Analyzing

## 8. Textbooks

1) Electrical measurement and instrumentation by U.A. Joshi (Technical Publication)
2) Electrical measurement and measuring instrument by R.K. Rajput

## 9. Reference Books

1) Electrical and Electronics measurements and instrumentation by A.K. Sawhney
2) Electrical Measurements and Instrumentation by J.B. Gupta

## 10. Open Sources (Website, Video, Movie)

1) https://onlinecourses.nptel.ac.in/
2) https://circuitglobe.com/
3) https://electrical-engineering-portal.com/
4) https://www.electrical4u.com/
5) https://tryengineering.org/profile/electrical-engineering/