



**Semester – III**

**Subject Name: Electrical Measurement and Instrumentation skill**

**Subject Code: 09EE1303**

**Diploma Branches in which this subject is offered:** Electrical Engineering

**Objective:** In the world of big industries, to maintain continuous and quality production an accurate and precise measurement of electrical and non-electrical quantities required. There are instruments like PMMC, MI, Potentiometer, Transducer, etc. used as measuring instruments, so diploma electrical engineers should be competent to use of this devices. They also be competent to calibrate and test these instruments. So this subject will develop skill of diploma electrical engineer to fulfil the industry need.

**Credits Earned:** 3 Credits

**Course Outcomes:** After learning the course the students should be able:

1. To understand importance and characteristics of measuring instrument.
2. To analyze classification of measuring instrument.
3. To understand measuring of different parameters.
4. To understand working of different measuring instruments.
5. To understand construction, operation, testing and calibration of different measuring instrument
6. To select measuring instrument for measurement of electrical and non-electrical quantities.

**Pre-requisite of course:** Basic knowledge of DC circuit, AC circuit

**Teaching and Examination Scheme**

Teaching Scheme (Hours)			Credits	Theory Marks			Tutorial/ Practical Marks		Total Marks
Theory	Tutorial	Practical		ESE	IA	CSE	Viva	Term work	
0	0	6	3	00	30	20	25	25	100



**Contents:**

<b>Unit</b>	<b>Topics</b>	<b>Contact Hours</b>	<b>Weightage (%)</b>
<b>1</b>	<b>Basics of measurement and instruments</b> <ul style="list-style-type: none"><li>• Importance of measurement</li><li>• Methods of measurement</li><li>• Functional elements of an instrument system</li><li>• Classification of measuring instrument</li><li>• Essentials of an indicating instrument Defalcating torque, controlling torque, damping torque</li><li>• Static characteristics Calibration, Precision, Accuracy, Repeatability, Reproducibility, Drift, Sensitivity, Resolution, True value</li><li>• Errors in measuring instruments</li><li>• Classification of error</li></ul>	<b>6</b>	<b>7</b>
<b>2</b>	<b>Measurement using Potentiometer</b> <ul style="list-style-type: none"><li>• Basic potentiometer circuit</li><li>• Types of potentiometers</li><li>• Laboratory type or Crompton's potentiometer</li><li>• Duo-range potentiometer</li><li>• Vernier potentiometer</li><li>• AC potentiometer</li><li>• Application of AC and DC potentiometers</li></ul>	<b>6</b>	<b>7</b>
<b>3</b>	<b>Resistance measurement and AC bridges</b> <ul style="list-style-type: none"><li>• Types of resistance Low, medium and high resistance</li><li>• Measurement of medium resistance Ammeter-voltmeter method, Ohmmeter method, Wheatstone bridge method</li><li>• Measurement of low resistance Ammeter-voltmeter method, Potentiometer method, Kelvin's double bridge method</li><li>• Measurement of high resistance Megger</li><li>• Measurement of earth resistance</li><li>• Importance of bridge circuit</li><li>• Measurement of impedance</li><li>• AC Bridges and its types</li></ul>	<b>20</b>	<b>24</b>
<b>4</b>	<b>Analog electrical meters</b> <ul style="list-style-type: none"><li>• Introduction</li><li>• Permanent magnet moving coil instrument Principle of PMMC instrument, merits and demerits of PMMC instrument</li></ul>	<b>28</b>	<b>33</b>



	<ul style="list-style-type: none"> <li>• Moving iron instrument Principle of MI instrument</li> <li>• MI type electrical instrument and meters Voltmeter, ammeter, power factor meter etc.</li> <li>• Electrodynamometer instrument Principle of electrodynamometer instrument, merits and demerits of electrodynamometer instruments.</li> <li>• Electrodynamometer type electrical meters Voltmeter, ammeter, power factor meter, etc.</li> <li>• Various meters for measurement of electrical quantities Induction type energy meter, static type energy meter, frequency meter, trivector meter, clip-on meter, phase sequence indicator and maximum demand meter.</li> <li>• Extension of range of voltmeter and ammeter.</li> <li>• Instrument transformers</li> <li>• Introduction to calibration</li> <li>• Importance of calibration</li> <li>• Calibration of various electrical meters as per IS Voltmeter, ammeter, wattmeter, etc.</li> <li>• Testing of electrical meters as per IS</li> </ul>		
<b>5</b>	<p><b>Transducer</b></p> <ul style="list-style-type: none"> <li>• Introduction to transducer</li> <li>• Types of transducer</li> <li>• Selection criterion of transducer</li> <li>• Errors in transducer</li> <li>• Various types of transducers Piezo-electric transducer, photo-electric transducer, resistive transducer, inductive transducer, capacitive transducer, Thermo-electric transducer, etc.</li> <li>• Measurement of non-electrical quantities using transducer Weight, thickness, displacement, velocity, speed, pressure, pH, strain, temperature etc.</li> </ul>	<b>24</b>	<b>29</b>

**List of Experiments**

Sr. No.	Unit No.	Name of Topics	Contact Hours
1	I	To study basic of measurement and instruments	6
2	II	Measurement of low resistance using potentiometer	6
3	III	Measurement of low resistance using kelvin's double bridge and ammeter-voltmeter method	4
4	III	Measurement of medium resistance using Wheatstone bridge and ammeter-voltmeter method	4



5	III	Measurement of high resistance using megger	4
6	III	Measurement of earth resistance using earth tester	4
7	III	Measurement of inductance and capacitance using LCR meter.	4
8	IV	Measurement of DC current, voltage and power	2
9	IV	Measurement of AC current, voltage and power	2
10	IV	Measure various electric quantities using multi-meter and clip-on meter	4
11	IV	Measurement of phase sequence using PSI	2
12	IV	Testing of ammeter, voltmeter and watt meter	4
13	IV	Study of energy meter and testing of energy meter, measurement of electrical energy using energy meter	6
14	IV	Measurement of frequency and power factor using frequency and power factor meter.	4
15	IV	Extension of range of voltmeter	2
16	IV	Extension of range of ammeter	2
17	V	Measurement of temperature using different transducer	4
18	V	Measurement of speed of induction motor using tachometer	2
19	V	Measurement of liner displacement using LVDT	4
20	V	Measurement of pressure using different transducer	4
21	V	Measurement of weight and strain using strain gauge	4
22	V	To study various type of transducer	6

**References:**

1. A. K. Sawhney, *“Electrical and Electronic Measurements and Instrumentation”*, Dhanpat Rai and Co., 2010.
2. S. K. Singh, *“Industrial Instrumentation and Control”*, Tata McGraw Hill Publishing company limited, eighteenth edition.
3. R. K. Rajput, *“Electrical Measurement and Measuring Instrument”*, S. Chand & company Pvt. Ltd., second edition.
4. K. Lal Kishor, *“Electrical Measurements and Instrumentation”*, Pearson, 2011.



**Instructional Method:**

- a. The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.
- b. The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory.
- c. Practical examination will be conducted at the end of semester for evaluation of performance of students in laboratory.
- d. Students will use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory
- e. Industrial visit related to subject

**Supplementary Resources:**

1. [https://nptel.ac.in/courses/108105053/pdf/L42\(GDR\)\(ET\)%20\(\(EE\)NPTEL\).pdf](https://nptel.ac.in/courses/108105053/pdf/L42(GDR)(ET)%20((EE)NPTEL).pdf)
2. <https://www.allaboutcircuits.com/technical-articles/instrumentation-and-control-an-introduction-to-the-basic-principles/>
3. <https://en.wikipedia.org/wiki/Measurement>
4. <http://phrontistery.info/unit.html>
5. [http://www.brainkart.com/article/D-C-and-A-C-Bridges\\_12734/](http://www.brainkart.com/article/D-C-and-A-C-Bridges_12734/)
6. [https://en.wikipedia.org/wiki/Potentiometer\\_\(measuring\\_instrument\)](https://en.wikipedia.org/wiki/Potentiometer_(measuring_instrument))
7. <https://www.electrical4u.com/potentiometer-working-principle-of-potentiometer/>
8. <https://www.quora.com/What-is-the-difference-between-moving-iron-and-moving-coil-instruments>