



Semester – III

Subject Name: Electrical Measurement and Instrumentation

Subject Code: 09EE2303

Diploma Branches in which this subject is offered: Electrical Engineering

Objective:

The aim of this course is to help the student to attain the industry identified competency through various use of relevant measuring instrument in different electrical applications.

Credits Earned: 3 Credits

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

1. To understand characteristics of measuring instrument.
2. To understand construction and working of different measuring instruments.
3. To analyze various measuring instruments by measuring parameter.
4. To apply fundamental knowledge to calibrate different measuring instrument
5. 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:

Unit	Topics	Contact Hours	Weightage (%)
1	Basics of measurement and instruments <ul style="list-style-type: none">• Fundamentals of measurement• Methods of measurement :Direct and indirect measurement• Classification of measuring instrument :Analog and digital instruments• Deflecting, controlling and damping torque• Static and dynamic characteristics: Calibration, Precision, Accuracy, Repeatability, Reproducibility, Drift, Sensitivity, Resolution, True value• Types of errors and Errors in measuring instruments• Indicating, recording and integrating instruments.• Essentials of an indicating instrument	4	5
2	Measurement using Potentiometers <ul style="list-style-type: none">• Types of Resistance measurement: Low, Medium and high• DC Potentiometer: Construction, working and application• Types of potentiometers :Dial types and Crompton type• AC potentiometer• Comparison of AC and DC potentiometers	6	8
3	Resistance measurement and bridges <ul style="list-style-type: none">• Types of resistance measurement: Low, medium and high• Measurement of medium resistance: Ammeter-voltmeter method, Ohmmeter method, Wheatstone bridge method• Measurement of low resistance: Ammeter-voltmeter method, Kelvin's double bridge method• Measurement of high resistance: Megger• Measurement of earth resistance• Importance of bridge circuit• Measurement of impedance• A.C. bridge to determine Inductance, capacitance and frequency• Digital Multimeter; L-C-R meter	24	28



4	<p>Electromechanical Instruments</p> <ul style="list-style-type: none"> • Permanent magnet moving coil instrument :Principle of instrument, merits and demerits • Moving iron instrument :Principle, construction and working • MI type electrical instrument and meters: Voltmeter, ammeter, power factor meter etc. • Electrodynamic instrument: Principle, construction, working merits and demerits. • Electrodynamic type electrical meters: Voltmeter, ammeter, power factor meter, etc. • Various meters for measurement of electrical quantities: Induction type energy meter, static type energy meter, frequency meter, clip-on meter, phase sequence indicator and maximum demand meter. • Extension of range of voltmeter and ammeter. • Importance of calibration • Calibration of voltmeter, ammeter and wattmeter 	24	29
5	<p>Transducer</p> <ul style="list-style-type: none"> • Introduction to transducer • Basic block diagram of transducer system and their function. • Classification of transducer: Based on transduction phenomenon, type of application, types of input and output signal, electrical principle involved. • Selection criterion of transducer • Errors in transducer • Various types of transducers: Piezo-electric transducer, photo-electric transducer, resistive transducer, inductive transducer, capacitive transducer, Thermo-electric transducer, etc. • Measurement of non-electrical quantities using transducer : Weight, thickness, displacement, velocity, speed, pressure, pH, strain, temperature etc. 	26	30

List of Experiments

Sr. No.	Unit No.	Name of Topics	Contact Hours
1	1	Identify measuring instruments on the basis of symbols on dial, type, accuracy, class position and scale.	4
2	2	Measurement of low resistance using potentiometer	6
3	3	Measurement of low resistance using kelvin's double bridge.	4
4	3	Measurement of medium resistance using Wheatstone bridge and ammeter-voltmeter method	4
5	3	Measurement of high resistance using megger.	4
6	3	Measurement of earth resistance using earth tester.	4
7	3	Measurement of inductance and capacitance using LCR meter.	4
8	3	Measure various electric quantities using multi-meter and clip-on meter	4



9	4	Identify the components of PMMC and MI instruments.	2
10	4	Measurement of phase sequence using PSI	2
11	4	Study of energy meter and testing of energy meter, measurement of electrical energy using energy meter	4
12	4	Calibrate single phase electronic energy meter by direct loading.	2
13	4	Measurement of frequency and power factor using frequency and power factor meter.	4
14	4	Troubleshoot ammeter, voltmeter and watt meter	4
15	4	Extend range of ammeter and voltmeter by using (i) shunt and multiplier (ii) CT and PT.	6
16	5	Measurement of temperature using different transducer	4
17	5	Measure angular speed using stroboscope and tachometer.	4
18	5	Measurement of liner displacement using LVDT	4
19	5	Measurement of pressure using different transducer	4
20	5	Measurement of weight and strain using strain gauge	4
21	5	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, MOOC setc.
- 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



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/
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>