

## NIRMA UNIVERSITY

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|------------------------------|--|
| <b>Institute:</b>            | <b>Institute of Technology</b>                 |
| <b>Name of Programme:</b>    | <b>B. Tech. in Electrical Engineering</b>      |
| <b>Semester:</b>             | <b>III</b>                                     |
| <b>Course Code:</b>          | <b>2EE501</b>                                  |
| <b>Course Title:</b>         | <b>Electrical Measurements and Transducers</b> |
| <b>Course Type:</b>          | <b>Core</b>                                    |
| <b>Year of Introduction:</b> | <b>2023 – 24</b>                               |

| L | T | Practical component |    |   |   | C |
|---|---|---------------------|----|---|---|---|
|   |   | LPW                 | PW | W | S |   |
| 2 | 0 | 2                   | -  | - | - | 3 |

### Course Learning Outcomes (CLOs):

At the end of the course, the students will be able to –

1. relate with the concepts of measurement and measurement systems (BL2)
2. articulate the construction and working of various measuring instruments (BL3)
3. select measuring instruments based on practical applications (BL4)
4. acquire knowledge on working, importance and applications of various transducers (BL3)

### Syllabus:

**Teaching Hours: 30**

|               |   |           |
|---------------|---|-----------|
| <b>Unit-1</b> | <b>Concepts of Measurements and Instrumentation</b>   | <b>03</b> |
|               | Introduction to measurement and instrumentation, Static and dynamic characteristics of instruments and instrumentation, errors in measurement.  |           |
| <b>Unit-2</b> | <b>Measurement of Resistance, Inductance and Capacitance</b>  | <b>04</b> |
|               | Measurement of low, medium and high resistance, Insulation resistance measurement, Concepts of A. C. bridges for inductance measurement - Maxwell, Hay's, Anderson and Owen bridges; Capacitance measurement – De'Sauty and Schering Bridge, Measurement of frequency by Wien's bridge.   |           |
| <b>Unit-3</b> | <b>Potentiometers and Instrument Transformers</b>   | <b>04</b> |
|               | Principle of D. C. potentiometer, direct reading potentiometers, accurate forms of potentiometers, A. C. potentiometer principle, types and applications of A. C. and D. C. potentiometers, Current and Potential Transformers, Burden, Ratio and phase angle errors, Current measurement using Rogowski coil.  |           |
| <b>Unit-4</b> | <b>Electrical Measuring Instruments</b>   | <b>11</b> |
|               | Classification of analog instruments, Operating forces, Construction and Principle of various analog measuring instruments, Miscellaneous instruments like- Power factor meter, Frequency meters and Synchroscope, Introduction to digital measuring instruments, Essentials of an electronic instruments, Advantages of electronic instruments, Types of electronic and digital voltmeters, Signal sampling concept in digital instruments, true r.m.s. reading voltmeter, vector voltmeter, electronic multimeter, electronic energy meter, electronic and digital LCR meter, tachometer, introduction to smart energy meter and PMU. |           |
| <b>Unit-5</b> | <b>Transducers</b>  | <b>08</b> |
|               | Classification and selection criterion for Transducers, Basics of thermometry and thermosensitive sensors, Capacitive, inductive and resistive type transducers for linear and angular displacement measurement, Pressure transducer, Flow and level transducer, Force, Torque, Weight, Strain, Piezo-electric transducers, Hall-effect   |           |

devices: current and voltage sensors, RVD, CVD sensors, low power CTs, Optical sensors, Ultrasonic transducers, sensors in automotive industries.

### **Self-Study:**

The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

### **Laboratory Work:**

This shall consist of at least 10 practical / simulations based on the above syllabus.

### **Suggested Reading:**

1. A. K. Sawhney, A course in Electrical Measurement and Measuring Instruments, Dhanpat Rai & Sons, New Delhi.
2. E. W. Golding and F. C. Widdis, Electrical & Electronic Measurements & Instrumentation, Reem Publications Pvt. Ltd.
3. B. G. Liptak, Instrument Engineer's Handbook Vol-2, CRC Press.
4. A. D. Helfrick and W. D. Cooper, Modern Electronic Instrumentation and Measurement Techniques, Pearson / Prentice Hall of India.
5. E. O. Doebelin, Measurement systems: Application & Design, McGraw-Hill Professional.
6. D. Patranabis, Principles of Industrial Instrumentation, Tata Mcgraw Hill.

### **Suggested List of Experiments (not restricted to the following):**

**(Only for Information)**

|     | <b>Title of Experiment</b>  | <b>Hrs.</b> |
|-----|---|-------------|
| 1.  | To perform the procedure for extension of range for ammeter and voltmeter.          | 2           |
| 2.  | To analyze three phase reactive power using one wattmeter method.                   | 2           |
| 3.  | To measure medium resistances using Wheatstone bridge.                              | 2           |
| 4.  | To measure low resistance using Kelvin's double bridge.                             | 2           |
| 5.  | To measure inductance by Anderson's and Hay's Bridge.                               | 2           |
| 6.  | To measure capacitance by De-Sauty's bridge.  | 2           |
| 7.  | To test the performance of single phase induction type energy meter.                | 2           |
| 8.  | To obtain and analyze the response of various thermo sensitive sensors.             | 2           |
| 9.  | To understand and perform various methods for measurement of displacement.          | 2           |
| 10. | To measure unknown weight using strain gauge.                                       | 2           |
| 11. | To analyze and apply different optical transducers for light intensity measurement. | 2           |
| 12. | To measure speed of rotating object using optical transducers.                      | 2           |

L = Lecture, T = Tutorial, P = Practical, C = Credit

w.e.f. academic year 2023 - 24 and onwards