| | |
|---|---|
| **COURSE TITLE** | **ELECTRONIC MEASUREMENT AND INSTRUMENTATION** |
| **COURSE CODE** | **01EC0314** |
| **COURSE CREDITS** | **4** |

**Objective:**

1 To provide knowledge of measurement principles, characteristics of instruments, electrical and electronic measurement techniques, and modern instrumentation systems relevant to electronics and communication engineering.

**Course Outcomes:** After completion of this course, student will be able to:

1 Describe measurement systems, standards, and sources of errors
2 Explain characteristics and working principles of measuring instruments
3 Illustrate techniques used for measurement of electrical quantities
4 Describe transducers, sensors, and modern instrumentation systems

**Pre-requisite of course:**Basic knowledge of electrical circuits and electronic devices

**Teaching and Examination Scheme**

| Theory Hours | Tutorial Hours | Practical Hours | ESE | IA | CSE | Viva | Term Work |
|---|---|---|---|---|---|---|---|
| 3 | 0 | 2 | 50 | 30 | 20 | 25 | 25 |

| Contents : Unit | Topics | Contact Hours |
|---|---|---|
| 1 | **Fundamentals of Measurement** Measurement Systems, Standards (Primary, Secondary, Working), Units and Dimensions, Types of Errors (Gross, Systematic, Random), Accuracy and Precision, Sensitivity, Resolution, and Calibration Methods | 6 |
| 2 | **Instrument Characteristics** Static Characteristics, Dynamic Characteristics, First Order Systems, Second Order Systems, Response of Instruments, Types of Instrument Response (e.g., step, ramp, impulse) | 6 |
| 3 | **Electrical Measuring Instruments** PMMC Instruments, Moving Iron Instruments, Electrodynamometer Instruments, Measurement of Voltage, Measurement of Current, Resistance Measurement – Wheatstone Bridge, Resistance Measurement – Kelvin Bridge, Inductance Measurement – Maxwell Bridge, Capacitance Measurement – Schering Bridge, Comparison of Electrical Measuring Instruments | 10 |

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| Contents : Unit | Topics | Contact Hours |
|---|---|---|
| 4 | **Electronic Instruments**<br>Digital Voltmeter (DVM), Digital Multimeter (DMM), CRO Construction, CRO Operation, Waveform Measurement using CRO, Signal Generators – Basics, Types of Signal Generators, Spectrum Analysis – Basics, Applications of Spectrum Analyzer, Comparison of Analog and Digital Instruments | 10 |
| 5 | **Transducers and Modern Instrumentation**<br>Transducers – Classification, Resistive Transducers, Inductive Transducers, Capacitive Transducers, Sensors – Basics, Signal Conditioning, Data Acquisition Systems (DAQ), Components of DAQ Systems, Introduction to Virtual Instrumentation, Applications of Virtual Instrumentation | 10 |
| **Total Hours** | | **42** |

**Suggested List of Experiments:**

| Contents : Unit | Topics | Contact Hours |
|---|---|---|
| 1 | **Experiment No. 1**<br>Perform calibration of voltmeter and ammeter using standard reference instruments | 2 |
| 2 | **Experiment No. 2**<br>Measure unknown resistance using Wheatstone bridge and verify the result | 2 |
| 3 | **Experiment No. 3**<br>Measure low resistance using Kelvin double bridge and compare with standard value | 2 |
| 4 | **Experiment No. 4**<br>Study the operation of Cathode Ray Oscilloscope (CRO) and observe different waveforms | 2 |
| 5 | **Experiment No. 5**<br>Measure frequency and phase difference of given signals using CRO | 2 |
| 6 | **Experiment No. 6**<br>Study the operation of digital multimeter and measure voltage, current, and resistance | 2 |
| 7 | **Experiment No. 7**<br>Measure inductance, capacitance, and resistance using LCR meter | 2 |
| 8 | **Experiment No. 8**<br>Study the characteristics of LVDT or strain gauge transducer and plot output response | 2 |
| 9 | **Experiment No. 9**<br>Perform signal conditioning using operational amplifier for a given sensor input | 2 |

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**Suggested List of Experiments:**

| Contents : Unit | Topics | Contact Hours |
|---|---|---|
| 10 | **Experiment No. 10**<br>Generate different waveforms using function generator and analyze their characteristics | 2 |
| 11 | **Experiment No. 11**<br>Determine measurement errors and calculate statistical parameters such as mean, variance, and standard deviation using experimental data | 2 |
| 12 | **Experiment No. 12**<br>Study basic data acquisition system using suitable interface and record measurement data | 2 |
| 13 | **Experiment No. 13**<br>Study the characteristics of temperature or light sensor and obtain calibration curve | 2 |
| 14 | **Experiment No. 14**<br>Demonstrate virtual instrumentation using suitable software tool for measurement and analysis | 2 |
| **Total Hours** | | **28** |

**Textbook :**


1 A Course in Electrical and Electronic Measurements and Instrumentation, A. K. Sawhney, Dhanpat Rai & Co., 2012

2 Electronic Instrumentation, H. S. Kalsi, McGraw-Hill Education, 2017


**References:**


1 Electronic Instrumentation and Measurements, Electronic Instrumentation and Measurements, D. A. Bell, Oxford University Press, 2013

2 Measurement Systems: Application and Design, Measurement Systems: Application and Design, E. O. Doebelin and D. N. Manik, McGraw-Hill, 2011

3 Principles of Measurement Systems, Principles of Measurement Systems, J. P. Bentley, Pearson Education, 2005


**Suggested Theory Distribution:**

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

| Distribution of Theory for course delivery | | | | | |
|---|---|---|---|---|---|
| **Remember / Knowledge** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Higher order Thinking / Creative** |
| 5.00 | 10.00 | 30.00 | 30.00 | 15.00 | 10.00 |

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**Instructional Method:**

1. The internal evaluation will be done based on the continuous evaluation of students in the laboratory and class-room.
2. A practical examination will be conducted at the end of the semester for evaluation of practical performance.
3. Students may use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory, etc.
4. The course delivery method will depend upon the requirements of content and need of the students. The teacher in addition to conventional teaching methods (Chalk and Talk) may use any of the tools/techniques such as demonstration, role play, Quiz, brainstorming, Flipped class, Project based learning, Collaborative learning, MOOCs etc. for effective teaching.

**Supplementary Resources:**

1. https://onlinecourses.nptel.ac.in/noc26_ee01/preview
2. https://elms-iitr.vlabs.ac.in/
3. https://www.multisim.com/

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