

DISCIPLINE SPECIFIC ELECTIVE COURSE – PHYSICS DSE 4: ELECTRONICS INSTRUMENTATION

Course Title & Code	Credits	Credit distribution of the course			Eligibility Criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical		
Electronics Instrumentation Physics DSE 4	4	2	0	2	Class XII pass with Physics and Mathematics as main subjects	Basics of digital electronics and analog electronics

LEARNING OBJECTIVES

This course aims to provide an exposure on basics of measurement and instrumentation and its various aspects and their usage through hands-on mode. It also aims to provide exposure of various measurement instruments such as power supply, oscilloscope, multivibrators, signal generators are also discussed. It also aims to develop an understanding of virtual instrumentation and transducers.

LEARNING OUTCOMES

At the end of this course, students will have understanding of,

- Basic principles of the measurement and errors in measurement, specifications of basic Measurement instruments and their significance with hands on mode.
- Principles of voltage measurement, advantages of electronic voltmeter over conventional multimeter in terms of sensitivity etc.
- Measurement of impedance using bridges, Power supply, Filters, IC regulators and Load and line regulation.
- Specifications of CRO and their significance, the use of CRO and DSO for the measurement of voltage (dc and ac), frequency and time period.
- Multivibrators, working circuits of astable and monostable multivibrators.
- Explanation and specifications of signal and pulse generators
- The Interfacing techniques, Arduino microcontroller and interfacing software,
- Understanding and usage of transducers

SYLLABUS OF PHYSICS DSE 4

THEORY COMPONENT

Unit – I

(12 Hours)

Measurements: Shielding and grounding, electromagnetic interference

Basic Measurement Instruments: DC measurement-ammeter, voltmeter, ohm meter, AC measurement, digital voltmeter systems (integrating and non-integrating), digital multimeter, block diagram, principle of measurement of I, V, C, measurement of impedance - A.C. bridges, measurement of self-inductance (Anderson's bridge), measurement of capacitance (De-Sauty's bridge), measurement of frequency (Wien's bridge)

Unit - II

(6 Hours)

Power supply: Using IC regulators (78XX and 79XX), line and load regulation, short circuit protection, idea of switched mode power supply (SMPS) and uninterrupted power supply

(UPS)

Oscilloscope: Block diagram, CRT, deflection (qualitative), screens for CRT, oscilloscope probes, measurement of voltage, frequency, and phase by oscilloscope, digital storage oscilloscope

Unit – III

(3 Hours)

Multivibrators (IC 555): Block diagram, astable and monostable multivibrator circuits
Signal Generators: Function generator (black box approach)

Unit – IV

(9 Hours)

Virtual Instrumentation: Introduction, interfacing techniques (RS 232, GPIB, USB), idea about Arduino microcontroller and interfacing software like Lab View
Transducers: Classification of transducers, measurement of temperature (RTD, semiconductor IC sensors), light transducers (photo resistors and photovoltaic cells)

References:

Essential Readings:

- 1) Electronic Instrumentation and Measurement Techniques, W. D. Cooper and A. D. Helfrick, 2005, Prentice Hall
- 2) Measurement Systems: Application and Design, E. O. Doebelin, 5th edition, 2003, McGraw Hill Book
- 3) Electronic Devices and Circuits, D. A. Bell, 2015, Oxford University Press

Additional Readings:

- 1) Instrumentation Devices and Systems, S. Rangan, G. R. Sarma and V. S. Mani, 1998, Tata McGraw Hill

PRACTICAL COMPONENT

(15 Weeks with 4 hours of laboratory session per week)

- Sessions on the construction and use of specific measurement instruments and experimental apparatuses used in the lab, including necessary precautions.
- Sessions on the review of experimental data analysis, sources of error and their estimation in detail, writing of scientific laboratory reports including proper reporting of errors.
- Application to the specific experiments done in the lab.”

At least eight experiments to be performed from the following list

- 1) Measurement of resistance by Wheatstone bridge and measurement of bridge sensitivity.
- 2) Measurement of Capacitance by De Sauty's bridge.
- 3) Design a regulated power supply of given rating (5 V or 9V).
- 4) To determine the Characteristics of Thermistors and RTD.
- 5) Measurement of temperature by Thermocouples.
- 6) To design an astable multivibrator of given specification using IC 555 Timer.
- 7) To design a monostable multivibrator of given specification using IC 555 Timer.
- 8) To design and study the sample and hold circuit.
- 9) To plot the frequency response of a microphone.
- 10) Glow an LED via USB port of PC.
- 11) Sense the input voltage at a pin of USB port and subsequently glow the LED connected with another pin of USB port.

References for laboratory work:

- 1) Measurement and Instrumentation Principles, A. S. Morris, 2008, Elsevier (Butterworth Heinmann)
- 2) Basic Electronics: A text lab manual, P. B. Zbar, A. P. Malvino and M. A. Miller, 1990, Mc-Graw Hill