

25UECT411	ELECTRONIC INSTRUMENTATION	Category	L	T	P	R	Credit	Year of Introduction
		PEC	3	0	0	0	3	2025

Preamble: This course covers the characteristics and classification of measuring instruments, along with detailed study of sensors and transducers for various physical parameters. In addition, it provides practical exposure to PLC programming for industrial automation and control applications.

Prerequisite: Nil

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

CO	Course Outcomes	Knowledge Level
CO1	Describe the basic concepts of measuring instruments, its classification, and selection criteria.	K2 Understand
CO2	Explain the principle, construction and working of transducers for measuring physical variables.	K2 Understand
CO3	Explain the principle, construction, and working of various bridge and electronic measuring instruments.	K2 Understand
CO4	Apply PLC programming for selected industrial processes.	K3 Apply

Mapping of course outcomes with program outcomes and program specific outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	1	2	1
CO2	3	2	1	-	-	-	-	-	-	-	2	3	2
CO3	3	2	2	-	-	2	-	-	-	-	2	3	2
CO4	2	2	3	1	-	3	-	-	-	-	3	3	3
Avg	2.75	2	2	1	-	2.5	-	-	-	-	2	2.75	2

Mapping of course outcomes with Knowledge and Attitude Profile (WK)

	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1	*	*	*	*				*	
CO2	*	*	*	*	*			*	
CO3	*	*	*	*	*		*	*	
CO4	*	*	*	*	*		*	*	

Wks Mapped with the course

WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
*	*	*	*	*		*	*	

Mark Distribution:

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	40	60	2.5 hrs

Continuous Internal Evaluation Pattern:

Attendance : 5 marks

Continuous Assessment Test : 20 marks Continuous Assessment Assignment: 15 marks

SYLLABUS

Module 1 (10 Hours)

Fundamentals of measuring instruments. Generalized structure and functional components of instrumentation systems. Importance and need for measurement systems. Classification of measuring instruments. Study of static and dynamic characteristics of instruments. Types of measurement data: static, dynamic, and transient. Performance parameters including rise time, response time, and settling time

Module 2 (11 Hours)

Introduction to sensors and transducers: classification and criteria for selection. Detailed study of operating principles, constructional features, theoretical background, merits, demerits, and applications of Resistive Transducers: Potentiometers; strain gauges (metallic and semiconductor types); resistance temperature detectors (RTDs); thermistors. Inductive Transducers: Linear Variable Differential Transformer (LVDT). Capacitive Transducers: Different configurations based on the fundamental capacitance relationship, including capacitive microphones, Opto-electrical Transducers: Photo emissive, photoconductive and photovoltaic transducers.

Module 3 (10 Hours)

Measurement techniques using bridges: Wheatstone bridge and guarded Wheatstone bridge. AC bridge circuits including Schering bridge, Owen's bridge, and Wagner earthing connection. Electronic measurement instruments: Digital Storage

Oscilloscope (DSO). Operating principles and applications of waveform analyzers, digital frequency meters, harmonic distortion meters, harmonic analyzers, and spectrum analyzers.

Module 4 (11 Hours)

Programmable Logic Controller (PLC) Programming: Basics of PLC operation. Programming of discrete ON/OFF inputs and development of ladder logic diagrams. Fundamentals of registers. Implementation of timers and counters. Arithmetic and comparison instructions. Data manipulation functions including skip instruction, master control relay (MCR) and its applications, jump instructions (with and without return), use of data tables, registers, and data transfer (move) functions.

Text Books:

1. Sawhney, A. K. (2023). *Electrical and electronics measurements and instrumentation*. Dhanpat Rai & Sons.
2. Doebelin, E. O., & Manik, D. N. (2011). *Doebelin's measurement systems* (6th ed.). Tata McGraw-Hill Education.
3. Hackworth, J. R., & Hackworth, F. D. (2022). *Programmable logic controllers: Programming methods and applications* (3rd ed.). Pearson

Reference Books:

1. Kalsi, H. S. (2019). *Electronic instrumentation* (4th ed.). Tata McGraw-Hill Education.
2. Webb, J. W., & Reis, R. A. (2015). *Programmable logic controllers: Principles and applications* (5th ed.). Pearson Education.
3. Oliver, B., & Cage, J. M. (2017). *Electronic measurements and instrumentation*. McGraw-Hill Education.

END SEMESTER EXAMINATION – MODEL QUESTION PAPER

Course Code	25UECT411
Course Name	ELECTRONIC INSTRUMENTATION
Max. Marks: 60	Duration: 2.5 Hours

Part A (Answer all questions. Each question carries 3 marks)				
Qn No.	Question	Marks	CO	BL
1	Explain the generalized structure of an instrumentation system with a neat block diagram	3	CO1	L2
	Differentiate between static and dynamic characteristics of			

2	measuring instruments. Give suitable examples	3	CO1	L2
3	Explain the classification of sensors and transducers, and describe the criteria for selecting a suitable transducer for a measurement application.	3	CO2	L2
4	Describe the differences between metallic strain gauges and semiconductor strain gauges in terms of their operating principle, sensitivity, and applications.	3	CO2	L2
5	Describe the construction and working principle of a Wheatstone bridge and state its applications	3	CO3	L2
6	Explain the functions and applications of a Digital Storage Oscilloscope (DSO) and describe how it differs from a conventional CRO.	3	CO3	L2
7	Explain the basic operation of a Programmable Logic Controller (PLC) and list its main components.	3	CO4	L2
8	In an automated bottle-filling plant, a PLC is used to control the filling process. The conveyor must stop for 10 seconds while a bottle is filled, and the system must also keep track of the total number of bottles processed. Identify whether a PLC timer or a PLC counter should be used for each task, and explain how they would be applied in the system.	3	CO4	L3

Part B

Answer any one full question from each Module. Each carries 9 marks)

Qn No.	Question	Marks	CO	BL
Module I				
9.	Describe the different classifications of measuring instruments and explain their static characteristics such as accuracy, precision, sensitivity, resolution, and linearity	9	CO1	L2
OR				
10.	Explain the dynamic characteristics of measuring instruments and describe the concepts of rise time, response time, settling time, and transient response.	9	CO1	L2
Module II				
11.	An engineer is designing a position-measurement system for a CNC machine and chooses an LVDT as the sensing element. Explain how the LVDT is constructed and operates, and discuss its advantages, limitations, and applications with the help of a suitable schematic diagram.	9	CO2	L2
OR				

12.	Explain the principles of operation of RTDs and thermistors and compare their characteristics and applications in temperature sensing.	9	CO2	L2
Module III				
13.	During the calibration of electrical components, a technician uses a Schering Bridge for capacitor testing and an Owen's Bridge for inductance measurement. Explain how each bridge operates, state the balance equations, and compare their features and applications in practical measurement systems.	9	CO3	L2
OR				
14.	Explain the operating principle, block diagram, and applications of a Spectrum Analyzer. Describe how it differs from a Waveform Analyzer and explain its advantages in frequency-domain measurements.	9	CO3	L2
Module IV				
15	In an automated bottling plant, bottles are counted as they pass a sensor. When 100 bottles are filled, the conveyor is paused for 5 seconds. The PLC calculates the production rate and compares it with the required daily target. Describe the use of timers, counters, arithmetic instructions, and comparison instructions in this application, supported by relevant ladder logic diagrams	9	CO4	L3
OR				
16	A PLC-based material handling system operates in normal, maintenance, and emergency modes. The maintenance mode requires disabling certain outputs using an MCR, some conveyor operations must be skipped under predefined conditions, and the controller must jump to emergency handling routines and return after fault clearance. Demonstrate the application of MCR, Skip Instructions, and Jump Instructions (with and without return) through suitable ladder logic diagrams.	9	CO4	L3