

Branch Name:	Electrical Engineering
Program Code:	ET109
Course Name:	Industrial Instrumentation (Department Elective-I)
Course Code:	1ET1090606
Pre-requisite Course:	Electrical measurement & measuring instruments.

Course Objectives:

1. Sound knowledge about various techniques used for the measurement of industrial parameters is essential for the student of engineering.
2. This subject provides the knowledge of measurement of force, displacement, flow, pressure, temperature using various types of sensors and related circuits.
3. The students will acquire the knowledge regarding selection of transducer based on its operating characteristics for the required application.

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)								
Lecture	Tutorial	Practical	Credit	Theory				Practical				Total
				University Assessment		Continuous Assessment		University Assessment		Continuous Assessment		
				Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
3	-	2	4	28	70	12	30	12	30	08	20	150

Course Contents:

Sr. No.	Topic	Total Hours	Weightage (%)
1	Transducers: Introduction to instrumentation system, static and dynamic characteristics of an instrumentation system, Principles and classification of transducers, Electrical transducers, basic requirements of transducers.	3	5
2	Strain Gauge and Strain Measurement: Factors affecting strain measurements, Types of strain gauges, Derivation of gauge factor, types of electrical strain gauges, gauging techniques and other factors, applications of strain gauges.	5	10
3	Displacement Measurement: Resistive potentiometer (Linear, circular and helical), L.V.D.T., R.V.D.T. and their characteristics, variable inductance and capacitance transducers, Piezo electrical transducers-output equations and equivalent circuit, Hall effect devices, Large displacement measurement using synchros and resolvers.	7	15
4	Forces and Torque Measurement: Load cells and their applications, Various methods for torque measurement.	3	10

5	Pressure Measurement: Introduction about Diaphragm, Bellows, and Bourdon tube for pressure measurement, Variable inductance and capacitance transducers, Piezo electric transducers, L.V.D.T. for measurement of pressure, Low pressure and vacuum pressure measurement using Pirani gauge, McLeod gauge, Ionization gauge, Pressure gauge calibration.	7	15
6	Flow Measurement: Differential pressure meter like Orifice plate, Venturi tube, flow nozzle, Pitot tube, Rotameter, Turbine flow meter, Electro-magnetic flow meter, hot wire anemometer, Ultrasonic flow meter.	7	15
7	Level Measurement: Resistive, inductive and capacitive techniques for level measurement, Ultrasonic and radiation methods, Air purge system (Bubbler method).	4	10
8	Temperature Measurement: Resistance type temperature sensors: RTD & Thermistor, Thermocouples & Thermopiles: Laws of thermocouple, Fabrication of industrial thermocouples, Radiation methods of temperature measurement: Radiation fundamentals, Total radiation & selective radiation pyrometers, Optical pyrometer.	5	10
9	Recorders: X - Y, strip chart and circular type graphic recorders - indicating, recording and Controlling instruments, multichannel recorders. Introduction to digital recorder.	4	10

Reference Books:

1. Industrial Instrumentation & Control by S. K. Singh, TMH Publication, 2006.
2. A course in Electrical and Electronics Measurement and Instrumentation by A. K. Shawney, Dhanpatrai & son's publications, 1998.
3. A course in Electrical & Electronic Measurement and Instrumentation by J.B.Gupta, S.K.kataria & Sons, 2002.
4. Principles of Industrial Instrumentation by D.Patranabis, 3rd edition, Mc Graw hill, 2009.

List of Experiments:

1. To Study the measurement and control of temperature using Resistance Temperature Detector.
2. To Study the measurement and control of temperature using Thermistor.
3. To perform the operation of Load Cell using Demonstrator.
4. To perform the operation of a Piezo Resistive Pressure Transducer using Demonstrator.
5. To perform the Synchros as an Error Detector.
6. To analyses the measurement of weight using Strain gauge.
7. To study the different types of Recorders.
8. To study the measurement of linear displacement using Linear Variable Differential Transformer.
9. To study Measurement of flow using orifice flow-meter.
10. To study Measurement of flow using venture tube.

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Understand the knowledge regarding selection of transducer based on its operating characteristics for the required application.	2 Understanding
CLO2	Analyze various available techniques and select appropriate to obtain satisfactory task for the parameter to be measured and know advantages and limitations of selected techniques.	4 Analyze 3 Applying
CLO3	Understand various techniques used for the measurement of industrial parameters is essential for the student of engineering.	2 Understanding
CLO4	To know about the techniques for measurement of force, displacement, flow, pressure, temperature using various types of sensors and related circuits.	1 Remembering
CLO5	Applying Resistive, inductive and capacitive techniques for level measurement	3 Applying
CLO6	Analyze Forces and Torque Measurement	4 Analyze

Mapping of CLOs with POs & PSOs

Course Learning Outcomes	Program Outcomes (POs)												Program Specific Outcomes(PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CLO1		L		L				M		L	M			L		
CLO2	L		M		L	L				H		L	L		M	L
CLO3		L		L				M			L					
CLO4	M							L		M			L		L	
CLO5			M		M									M		
CLO6		H		M		L		L			M	L				L

H: High, M: Medium, L: Low