GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering Syllabus

Subject Code : 3154703

Subject Name : Instrumentation in Industry

WEF Academic Year:	2024-2025
Semester:	5
Category of the Course:	Open Elective I

Prerequisite :	**Concepts of physical measurements, basics of sensors and measuring instruments**
Rationale :	Industrial instruments are used in different setups and applications: For example in industrial process control where the quality of specific production and joining processes is checked. Certain applications of measuring instruments may be characterized as having essentially a monitoring function, e.g., strain measurement, displacement measurement, analytical parameter humidity, temperature measurement, automotive speedometer and fuel gage. These are the one of the most important classes of measurement application.

Course Scheme:

Teaching Scheme			Total Credits	Assessment Pattern and Marks				Total Marks
				Theory		Practical		
L	T	PR	C	ESE (E)	PA(M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Course Content:

Sr. No.	Course Content	No. of Hours	% of Weightage
1	**Displacement Measurement** • Electrical Transducers: Resistive (Potentiometer – linear and angular) and Inductive (LVDT, RVDT and Synchros) • Optical Transducers: Laser Transducer (Triangulation and Time of Flight methods) • Ultrasonic Transducers • Magnetostrictive Transducers • Digital Displacement Transducers: Tachometer, incremental and Absolute types Encoders • Proximity Sensors: Inductive, Capacitive and Optical	10	22
2	**Strain Measurement** • Stress-strain relations • Principle of Resistance Strain Gauge • Types of Strain Gauges • Strain Measurement Methods – Current Injection, Ballast and Bridge circuits and their compensation techniques	08	18

	• Calibration of Strain Guages		
3	**Acceleration, Force, Torque and Speed Measurement** • Piezoelectric Accelerometer, Vibration Measurement • Force measurement: Proving Ring and Load Cell • Industrial weighing system: Manual and Continuous Conveyor belt weighing and Weigh Feeders • Torque measurement: Dynamometers and its types and Strain Gauge • Tachometers: Fly-ball Tachometer, Stroboscope, Encoder (optical as well)	08	18
4	**Miscellaneous Measurements** • Humidity and Moisture measurement: Wet and Dry Bulb Hygrometer, Mechanical Hygrometer, Resistive Hygrometer, Capacitive Hygrometer, Piezoelectric Hygrometer and Chilled Surface dew point measurement. • Density measurement: Hydrometers and Air purge method • Conductivity meter • pH meter • Viscosity measurement: Ostwald Viscometer and Saybolt and Redwood Viscometer	10	22
5	**Analytical Instrumentation** • Oxygen Analyser: Paramagnetic (Deflection type, magnetic wind type and differential pressure type. • Corbon di oxide and Carbon mono oxide Analyser: IR and Thermal Conductivity • Chromatography and its types • Radiation detectors: Geiger Muller Counter, Ionisation Chamber and Scintillation Counter • Sample handling systems	09	20
	Total	**45**	**100**

Reference Book:

1. Introduction to Instrumentation and Control by A. K. Ghosh, 4th edition, PHI publications
2. Instrument Engineers' Handbook: Process Measurement and Analysis by B. G. Liptak.
3. Handbook of Applied Instrumentation by D. M. Considine and Sidney David Ross, McGraw – Hill publication.
4. Encyclopedia of Instrumentation and Control by D. M. Considine, Krieger publication Co.
5. Instrumentation Reference Book by Walt Boyes, Butterworth – Heinemann publisher.
6. Industrial Instrumentation by K. Krishnaswamy and S. Vijayachitra, New Age International Publication.
7. Measurement Systems: Application and Design by E. D. Doeblin, McGraw – Hill Publication.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT

		Level*
01	Understand the basic measurement principles of displacement, strain, acceleration, force, torque and other analytical parameters.	RM
02	Identify the type of sensor and their relevant specification .etc which can be used in a particular process parameter measurement selection.	AP
03	Understand the concepts of various analytical methods used for instrumental techniques used for physical, chemical, quantitative and qualitative analysis	UN
04	Design and conduct experiments for measurement, characterization and able to analyze and interpret data.	AN
05	Understand and identify various instruments for environmental health monitoring and quality control applications	UN

*RM: Remember, UN: Understand, AP: Apply, AN: Analyze, EL: Evaluate, CR: Create

Suggested Course Practical List:

1. Characterization and calibration of potentiometer based displacement sensor
2. Characterization and calibration of LVDT as displacement sensor
3. Measurement of strain on a beam using strain gauge.
4. Characterization and calibration of speed measurement system. (Tachometer, Photoelectric and magnetic Pick-up).
5. Characterization and calibration of vibration measurement system. (Piezoelectric)
6. Characterize the Proximity sensors (inductive)
7. Case study based on applications of sensors used in auto industry
8. Case study based on applications of sensors used in process industry.
9. To calibrate pH measurement system and to measure pH of given sample.
10. To analyze a given water sample using conductivity meter, hygrometer, viscosity, density etc.

List of Laboratory/Learning Resources Required:

1. LVDT
2. RVDT
3. Potentiometers
4. Hygrometers
5. Tachometers
6. Strain Gauge
7. Load Cell
8. Proximity Sensors
9. Piezoelectric sensor
10. pH meter

* * * * * * *