



# C.U.SHAH UNIVERSITY

**FACULTY OF:** Technology & Engineering

**DEPARTMENT OF:** Instrumentation & Control Engineering

**SEMESTER:** V

**COURSE:** B.Tech

**SUBJECT CODE:** 4TE05IMT1

**SUBJECT NAME:** Industrial Measurement

## Teaching & Evaluation Scheme

Subject Code	Subject Name	Teaching Hours/Week				Credits	Evaluation Scheme/Semester							
		Th	Tu	Pr	Total		Theory				Practical			Total Marks
							Sessional Exam		University Exam		Internal		University	
							Marks	Hrs	Marks	Hrs	Pr/Viva	TW	Pr	
4TE05IMT1	Industrial Measurement	4	0	2	6	5	30	1.5	70	3	--	20	30	150

### OBJECTIVES:

1. To introduce the students to various sensors and transducers used in Industrial measurement purposes.

### PREREQUISITES:

1. A basic course in Transducers and Measurement.

### COURSE OUTLINES:

Sr. No.	Course Contents	No Of Hours
1	<b>Introduction:</b> Introduction To Chemical Analysis; Chromatography; General Chromatography, Paper Chromatography And Thin-Layer Chromatography, Polarography And Anodic Stripping Voltammetry; Polarography, Anodic Stripping Voltammetry, Thermal Analysis.	4
2	<b>Spectroscopy:</b> Introduction; Absorption And Reflection Techniques; Infrared, Absorption In UV, Visible And IR, NIR, Absorption In The Visible & Ultraviolet, Measurement Based On Reflected Radiation, Chemiluminescence, Atomic Techniques: Emission, Absorption, And Fluorescence; Atomic Emission Spectroscopy, Atomic Absorption Spectroscopy, Atomic Fluorescence Spectroscopy, X-Ray Spectroscopy; X-Ray Fluorescence Spectroscopy, X-Ray Diffraction, Photo-Acoustic Spectroscopy;	10

	Microwave Spectroscopy; Electron Paramagnetic Resonance(EPR), Nuclear Magnetic Resonance Spectroscopy, Neutron Activation; Mass Spectrometers; Principal Of The Classical Instruments, Inlet Systems, Ion Sources, Separation Of The Ions, Other Methods Os The Separation Of Ions.	
3	<b>Electrochemical Techniques:</b> Alkalis; Ionization Of Water; Electrical Conductivity; Electrical Conduction In Liquids, Conductivity Of Solutions, Practical Measurement Of Electrical Conductivity, Application Of Conductivity Measurement, The Concept Of Ph; General Theory, Practical Specification Of Ph Scale, pH Standards, Neutralization, Hydrolysis, Common ion Effect, Buffer Solutions, Electrode Potentials; General Theory, Variation Of Electrode Potential With Ion Activity (The Nearst Equation), Ion-Selective Electrodes; Glass Electrode, Solid-State Electrodes, Heterogeneous Membrane Electrodes, Liquid Ion Exchange Electrodes, Gas-Sensing Membrane Electrodes, Redox Electrodes, Potentiometry And Specific Ion Measurement; Reference Electrodes, Measurement Of pH, Measurement Of Redox Potential, Determination Of Ions By Ion-Selective Electrodes, Common Electrochemical Analyzers; Residual Chlorine Analyzer, Polarographic Process Oxygen Analyzer, High-Temperature Ceramic Sensor Oxygen Probes, Fuel Cell Oxygen Measuring Instruments, Hersch Cell For Oxygen Measurement, Sensor For Oxygen Dissolved In Water, Coulometric Measurement Of Moisture In Gases & Liquid.	10
4	<b>Gas Analysis:</b> Introduction; Separation Of Gaseous Mixtures; Gas Chromatography, Detectors; Thermal Conductivity Detector(Tcd), Flame Ionization Detector(Fid), Photo-Ionization Detector(PID), Helium Ionization Detector, Electron Capture Detector, Flame Photometric Detector(FPD), Ultrasonic Detector, Catalytic Detector(Prllistor), Semiconductor Detector, Properties And Application Of Gas Detector, Process Chromatography; Sampling Systems, Carrier Gas, Chromatography Column, Controlled Temperature Enclosures, Detectors, Programmers, Data-Processing Systems, Operation Of A Typical Process Chromatograph, Special Gas Analyzers; Paramagnetic Oxygen Analyzers, Ozone Analyzers, Oxides Of Nitrogen Analyzers, Summery Of Special Gas Analyzers, Calibration Of Gas Analyzers; Static Methods, Dynamic Methods.	10
5	<b>Moisture Measurement:</b> Introduction; Definitions; Gases, Liquids & Solids, Measurement Techniques; Gases, Liquids, Solids, Calibration; Gases, Liquids, Solids.	2
6	<b>Measurement of Viscosity:</b> Introduction; Newtonian And Non-Newtonian Behavior; Measurement Of Other Share Viscosity; Capillary Viscometer, Couette Viscometer, Cone-And-Plate Viscometer, Parallel-Plate Viscometer, Shop-Floor Viscometers; Measurement Of	5

	The Extensional Viscosity; Measurement Of Viscosity Under Extremes Of Temperature & Pressure; Online Measurement; Accuracy & Range	
7	<b>Measurement of Strain:</b> Strain; Bonded Resistance Strain Gauge; Wire Gauges, Foil Gauges, Semiconductor Gauges, Rosettes, Residual Stress Measurement, Gauge Characteristics; Range, Cross-Sensitivity, Temperature Sensitivity, Response Times, Installation; Circuits For Strain Gauge; Vibrating Wire Strain Gauge; Capacitive Strain Gauges; Surveys Of Whole Surfaces; Brittle Lacquer, Patterns Of Surfaces, Photo elasticity	5
8	<b>Vibration and Sound Measurement</b> Vibration: Introduction, Vibration measurement system, Sound: Sound level meter, microphones, pressure response of a capacitor microphone, acoustic intensity and emission.	3
9	<b>Measurement of Force:</b> Basic Concepts; Force Measurement Methods; Lever Balance Methods –Equal lever balance, Unequal lever balance, Compound lever balance; Force Balance Methods; Hydraulic Pressure Measurement; Acceleration Measurement; Elastic Elements – Spring balances, proving rings, Piezoelectric transducers, strain – gauge load cells; latest developments	3

### Learning Outcomes

- Understand fundamentals of Industrial measurement.
- Have a broad understanding of the applications of various sensors and transducers available for industrial measurements
- Develop and apply engineering concepts for a range of problems after studying this course.

### Books Recommended:

1. Instrumentation Reference Book by Walt Boyes, Pub: Elsevier
2. Applied Instrumentation in the Process Industries Vol. I and II, by W. G. Andrews and H. B. Williams, Pub: Gulf Publishing.
3. Principles of measurement and instrumentation by Alan Morris, PHI