

# GUJARAT TECHNOLOGICAL UNIVERSITY

B. E. SEMESTER: VI

Instrumentation and Control Engineering

Subject Name: **Instrumentation Measurement – II**

Subject Code: **161705**

Teaching Scheme				Evaluation Scheme		
Theory	Tutorial	Practical	Total	University Exam (Theory) (E)	Mid Sem Exam (Theory) (M)	Practical (I)
4	0	2	6	70	30	50

## Part – I Mechanical Measurement:

Sr. No	Course Content	Total Hrs.
1.	<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 The Extensional Viscosity; Measurement Of Viscosity Under Extremes Of Temperature & Pressure; Online Measurement; Accuracy & Range	4
2.	<b>Measurement of Length:</b> Introduction; The Nature Of Length; Derived Measurement; Standard & Calibration Of Length; Practice For Length Measurement For Industrial Use; General Remarks, Mechanical Length Measuring Equipment, Electronic Length Measurement, Use Of Electromagnetic And Acoustic Radiation, Miscellaneous Methods, Automatic Gauging Systems	5
3.	<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

4.	<b>Vibration:</b> Introduction; Physical Considerations, Practical Problems Of Installation, Areas Of Application, Amplitude Calibration; Accelerometer Calibration, Shock Calibration, Force Calibration, Sensor Practice; Mass-Spring Seismic Sensors, Displacement Measurement, Velocity Measurement, Acceleration Measurement, Measurement Of Shock, literature	3
5.	<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	4
6.	<b>Measurement of Density:</b> General; Measurement Density Using Weight; Measurement Density Using Buoyancy; Measurement Density Using A Hydrostatic Head; General Differential Pressure Transmitter Method, DP Transmitter With Overflow Tank, DP Transmitter With A Wet Leg, DP Transmitter With A Pressure Repeater, DP Transmitter With Flanged Or Extended Diaphragm, DP Transmitter With Pressure Seals, DP Transmitter With Bubble Tubes, Other Process Considerations, Measurement Density Using Radiation; Measurement Density Using Resonant Element; Liquid Density Measurement, Gas Density Measurement, Relative Density Of Gases	4

### Part – II Chemical Analysis:

Sr. No	Course Content	Total Hrs.
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, 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; Microwave Spectroscopy; Electron Paramagnetic Resonance(EPR), Nuclear Magnetic Resonance Spectroscopy, Neutron	6

	Activation; Mass Spectrometers; Principal Of The Classical Instruments, Inlet Systems, Ion Sources, Separation Of The Ions, Other Methods Os The Separation Of Ions	
3.	<p><b>Electrochemical Techniques:</b></p> <p>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 &amp; Liquid</p>	7
4.	<p><b>Gas Analysis:</b></p> <p>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.</p>	7
5.	<p><b>Moisture Measurement:</b></p> <p>Introduction; Definitions; Gases, Liquids &amp; Solids, Measurement Techniques; Gases, Liquids, Solids, Calibration; Gases, Liquids, Solids.</p>	2

6.	<b>Application Guidelines for Analytical Systems:</b> Factor In Successful Applications, Sample Systems, Basic Principles, Sample Location, Filters, Sampling Time Lags, Sample Conditioning, Sample Disposal, Typical Sample Systems, Evaluating Analyzer Components, Chromatographs, Infrared Analyzers, Conductivity Measurements, PH Measurements, Analyzer Housing, Purpose, Construction, Utilities Required.	5
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### **Text Books:**

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

### **Reference Books:**

1. Instrumental Methods of Chemical Analysis by Galen W. Ewing, Pub: McGraw Hill International
2. Handbook of Analytical Instrumentation by R. S. Khandpur, Pub: Tata – McGraw Hill
3. Instrument Engineers' Handbook (Vol. – II) by B. G. Liptak; Pub: CRC Press