

		1
<h2 style="margin: 0;">Analytical Transmitters</h2> <h3 style="margin: 0;">Vibration Measurement</h3> <h3 style="margin: 0;">Electrical Power</h3> <p style="margin: 5px 0;">Daniel Kohn University of Memphis TECH 3821 Fall 2015</p>		

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<h2 style="margin: 0;">Analytical Transmitters</h2>		

	Conductivity	3
	<ul style="list-style-type: none"> Two-electrode conductivity probes <div style="display: flex; justify-content: space-around; align-items: flex-start;"> <div style="text-align: center;"> <p style="font-size: small;">Sample liquid</p> <p style="font-size: x-small;">Area = A</p> <p style="font-size: x-small;">Distance = d</p> <p style="font-size: x-small;">$G = \frac{I}{V}$</p> <p style="font-size: x-small;">$G = \frac{kA}{d}$</p> </div> <div style="text-align: center;"> <p style="font-size: x-small;">4-wire ohmmeter</p> <p style="font-size: x-small;">4-wire cable</p> <p style="font-size: x-small;">Sample wire</p> <p style="font-size: x-small;">Distance = d</p> <p style="font-size: x-small;">Area = A</p> <p style="font-size: x-small;">$R = \frac{V}{I}$</p> <p style="font-size: x-small;">$R = \frac{\rho d}{A}$</p> </div> </div>	

Electrodeless Conductivity Probe

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- uses electromagnetic induction rather than direct electrical contact to detect the conductivity of the liquid solution

pH

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- pH is the measurement acidity or alkalinity in a liquid solution.
- Colorimetric pH measurement
 - simplest ways to measure the pH of a solution is by color (Litmus Paper)

pH

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- Potentiometric pH measurement – Electrochemical measurement using special pH-sensitive electrodes that will generate a voltage dependent on pH

Nernst equation

$$V = \frac{RT}{nF} \ln \left(\frac{C_1}{C_2} \right)$$

Where,
 V = Voltage produced across membrane due to ion-exchange (volts)
 R = Universal gas constant (8.315 J/mol*K)
 T = Absolute temperature (Kelvin)
 N = Number of electrons transferred per ion-exchanged (unitless)
 F = Faraday constant, in coulombs per mole (96485 C/mol e⁻)
 C1 = Concentration of ion in measured solution (moles/liter of solution, M)
 C2 = Concentration of ion in reference solution (moles/liter of solution, M)

pH

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- pH Probe

The diagram shows a pH probe assembly with a built-in preamplifier. It includes a glass measurement electrode and a reference electrode. Labels indicate connections for DC power to the probe, a Nernst potential to the pH instrument, and an RTD signal to the pH instrument. The graph plots Probe voltage (mV) on the y-axis (from -180 to 0) against pH on the x-axis (from 12 to 2). A linear trendline is shown with the equation $Slope = 45.8 \text{ mV/pH}$. Two specific points are marked: at pH 10.00, the voltage is -152 mV; at pH 4.02, the voltage is -165 mV.

Chromatography

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- technique of chemical separation by time-delayed travel down the length of a stationary medium (called a column)

The diagram illustrates the three steps of Thin-layer chromatography (TLC):
Step 1: A "Plate" is placed in a beaker. A solvent is at the bottom, and a sample spot is placed on the plate.
Step 2: The solvent "wicks" up the plate, carrying the sample components with it.
Step 3: The components are separated into Component "A" (blue) and Component "B" (red) as they travel at different rates up the plate.

As solvent wicks up the surface of the plate, it carries along with it all components of the sample spot. Each component travels at a different speed, separating the components along the plate over time.

Automatic Chromatography

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The schematic diagram shows the components of an automatic chromatography system: Carrier gas supply (for gas chromatographs only), Shutoff valve, Pressure regulator, Sample in, Sample valve, Column, Detector, and Vent. A Programmable controller is connected to the Sample valve and the Detector. The chromatogram below shows the Detector signal over Time, with five distinct peaks labeled 1 through 5. Peak 1 is the first component to exit the column, and peak 5 is the last.

	Gas Chromatography	10
<ul style="list-style-type: none"> Flame ionization detectors (FID) work on the principle of ions liberated in the combustion of the sample component 		

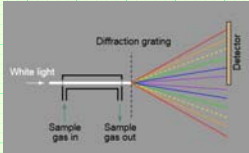
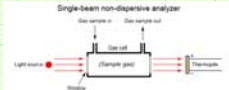
	Gas Chromatography	11
<ul style="list-style-type: none"> Thermal conductivity detectors (TCD) work on the principle of heat transfer by convection (gas cooling) 		

	Gas Chromatography	12

Spectroscopy

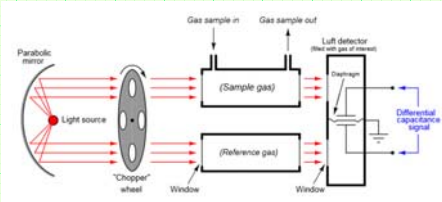
13

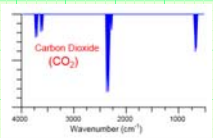
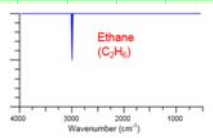
- Spectroscopy is the use of the absorption, emission, or scattering of electromagnetic radiation by matter to qualitatively or quantitatively study the matter or to study physical processes.
- ie use light through a substance and look at the spectrum of light produced

Luft Detector


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Safety Gas Analyzers

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LOW ALARM

10.0 35

19.5 10

HIGH ALARM



15.0 200

23.5 20

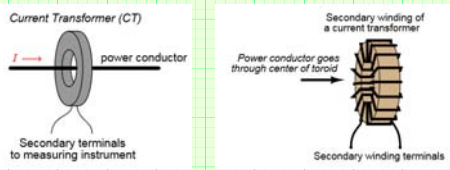
			16
	<h1>Vibration Measurement</h1>		

	Sinusoidal Vibrations	17
	<ul style="list-style-type: none">• a rotating wheel is unbalanced by the presence of an off-center mass, the resulting vibration will take the form of a cosine wave as measured by a displacement (position) sensor	

	Vibration	18

Mechanical vibration Switches		19
		
<p>This switch works on the principle of a weighted lever generating a force when shaken. A pair of magnets located at the weighted end of the lever hold it in either the "reset" (normal) or "tripped" position:</p>		
		

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<h1>Electrical Power</h1>		

Current Transformer		21
		
<p>Secondary terminals to measuring instrument</p>		
