Basics Control Loops **Block Diagrams** Terms Manipulated Variable, Disturbance, Measured Variable Process Time Constants (K_p , τ_p , θ_p) Control Time Constants (K_C, τ_{I} , τ_{D}) $u(t) = u_{bias} + K_{C}e(t) + \frac{K_{C}}{\tau_{C}}\int e(t)dt + K_{C}\tau_{D}\frac{de(t)}{dt}$ **Tuning Relations** Feedback Control, Feedforward Control Open Loop, Closed Loop Linear vs. Nonlinear Systems Bias, Offset, Reset Windup, Derivative Kick, Derivative on Measurement Oscillations, Overshoot, Decay Ratio, Noise Valves - Fail open, Fail Closed, etc. - linear, equal percentage, square root, etc. - 1, f(1) P, PI, and PID control (and variations like w/D on meas., etc.) Application FOPDT Model $y(t) = y_0 + K_p \Delta u \left[1 - \exp\left(-\frac{t}{t} - \theta_p \right)/\tau_p \right) \right]$ Graphical fitting Fitting using ControlStation software (step, pulse, doublet) Methods for obtaining tuned controller constants (IAE, ISE, ITAE) General Rules (Effect of Dead Time on K_C, etc.) When to use P, PI, and PID control Open loop testing vs. Continuous loop testing Troubleshooting ideas Effect of system on control valve operation and control (Long pipe vs. Short pipe, etc.) Demonstration Control Station Software (how to use, why use it, limitations) Process Control Equipment - Temperature Measurement (Thermocouple, etc.) - Flow Meters and Controllers