

Process Control: Pressure

Catalogue Number	77-3044-0002
Category	Process Control
Duration	15 Hours

Activity 1: Introduction to Process Control

What is Process Control? What is a Control Mechanism? What is a Controller? The Need for Controlling Systems Activity 2: Introduction to ProcessMotion Simulation Software **ProcessMotion Software** Manipulating the ProcessMotion Panel Display Task: Running ProcessMotion and Manipulating the Display **Review of Process Control** Task: Running an Experiment **Output Analysis** Task: Analyzing the Output Graph Simulating an Ineffective Controller Task: Running a Simulation of an Ineffective Controller Interpreting the Output Graph Simulating An Effective Controller Task: Running a Simulation of an Effective Controller Interpreting the Output Graph Simulating Another Effective Controller Task: Running a Simulation of an Effective Controller Interpreting the Output Graph



Activity 3: Block Diagrams and Gain

- Systems and Control Systems
- Sample Control Systems
- **Block Diagrams**
- Open Loop Control Systems and Gain
- Testing a Control System
- Task: Testing a Control System
- Testing Another Control System

Activity 4: Calculating Process Gain

Review of Gain ProcessMotion Panel Control System Task: Constructing the Block Diagram of the System Process Gain of the ProcessMotion System Calculating the Process Gain Analytically Fluid Dynamics Analyzing the Process Gain Equation Task: Calculating the Process Gain Analytically Calculating the Process Gain Experimentally Task: Calculating the Process Gain Experimentally Task: Completing the Table



Activity 5: Calculating the Final Control Element Gain

Final Control Element Gain The E/P Converter Task: Observing the Internal Functioning of the E/P Converter Task: Resetting the System The Pressure Control Valve (PCV) Task: Observing the Internal Functioning of the PCV System Task: Calculating the System Gain Experimentally Task: Increasing the E/P Setting Task: Calculating the E/P Gain Task: Calculating the PCV Gain Task: Calculating the Final Control Element Gain Task: Completing the Table Result Analysis Calculating The System Gain

Activity 6: First Order Systems

Steady State Response Dynamic Response The Time Constant First Order Systems First Order System Laplace Transforms Step Inputs First Order System Response to a Step Input Notes on the Time Constant Task: Constructing a Graph of System Response to a Step Input Task: Interpreting a System Response Graph



Activity 7: The Pressure System Time Constant

Review of the Time Constant The System Order of the Pressure System Determining the Dynamic Response of a First Order System Measuring the Pressure System Time Constant Experimentally Example: Measuring Tau Experimentally Task: Measuring the Time Constant Task: Reviewing the Graph and the Block Diagram Deriving the Pressure System Time Constant Analytically Analysis of the Time Constant Formula Task: Calculating the Time Constant Analytically

Activity 8: Controlling the Pressure System Using Open Loop Control

Categorizing Control Systems Closed Loop Control Open Loop Control Controlling the Pressure System Using Open Loop Control Task: Using Open Loop Control to Control the Value of Pout Task: Calculating the Setting for Other Pout Values Using Open Loop Control to Set Pout for Different Pressure Systems Task: Using Open Loop Control to Set Pout for Different Pressure Systems Task: Verifying Your Results Result Analysis

Activity 9: Introduction to On-Off Control

Open and Closed Loop Control Systems Closed Loop Control Systems On-Off Control Algorithm Task: Analyzing a Control System Applying On-Off Control On-Off Control Using Dead Band Tolerance



On-Off Control

Activity 10: On-Off Control - Tasks

Step Inputs Task: Step Inputs Task: Calculating General System Information System Behavior Task: Calculating the System Output Over Time The Descent of the System Response Task: Plotting the System Descent Investigating the Effects of Changing the Dead Band Task: Investigating the Effects of Changing the Dead Band

Activity 11: Controlling the Pressure System Using On-Off Control

Review of Open Loop Control of the Pressure System On-Off Control of the Pressure System Task: Controlling the Pressure System Using On-Off Control Analysis of the System Output Task: Analysis of the Output Graph Task: Completing the Task Analysis of the Experiment Results

Activity 12: Proportional Control

Proportional Control Algorithm Saturation **Proportional Band** Steady State System Characteristics Under Proportional Control Dynamic System Characteristics Under Proportional Control



Activity 13: First Order Systems Under Proportional Control

Review of Proportional Control

System Response to a Step Input

Task: Calculating Time Values

Task: Calculating the System Output for Kc = 0.5

Task: Calculating the System Output for Kc = 1

Task: Calculating the System Output for Kc = 2

Task: Calculating the System Output for Kc = 4

Task: Calculating the System Output for Kc = 10

Activity 14: Controlling the System Using Proportional Control

Review of On-Off Control of the Pressure System Proportional Control of the Pressure System Task: Controlling the System Using Proportional Control Task: Recording the Experiment Results Results and Conclusions Task: Investigating the Effect of Increasing the Proportional Controller Gain Kc Task: Recording the Experiment Results Task: Completing the Experiment Results and Conclusions

Activity 15: Proportional Integral Control

First Order Systems Under Proportional Control Higher Order Systems Under Proportional Control Integral Control Proportional Integral Control Task: Constructing a Graph of the Output of a PI Controller How Integral Control Eliminates Offset Disadvantages of PI Control Applying Laplace Transform to PI Control



Activity 16: Controlling the Pressure System Using PI Control

Review of Proportional Control

Controlling The Pressure System Using PI Control

Task: Controlling the Pressure System with PI Control

Task: Recording the Data

Task: Completing the Experiments

Results and Conclusions

Activity 17: PID Control

Review of Proportional Control Review of Proportional Integral Control Derivative Control Advantages of Applying a Derivative Action to a PI Controller Proportional Integral Derivative Control Demonstrating PID Control Task: Investigating the Effect of Changing PID Parameters Task: The Effect of Changing the Value of Kc Task: The Effect of Changing the Value of Ti Task: The Effect of Changing the Value of Td

Activity 18: Controlling the Pressure System Using PID Control

Review of P and PI Control Control of Higher Order Systems Review of PID Control Task: Controlling the ProcessMotion Pressure System with a PID Controller Results and Conclusions Task: Investigating the Effect of PID Control on a Higher Order System Task: Adjusting the Value of Kc When Using P Control Task: Adjusting the Value of Ti When Using PI Control Task: Adjusting the Value of Td When Using PID Control



Activity 19: Controller Selection and Design

Designing a Control System Stage 1: Selecting an Appropriate Control Algorithm Stage 2: Determining the Correct Parameters Stage 3: Fine Tuning Setting the Parameters for a PID Control System Task: Determining the Critical Gain Value Task: Determining the Cycle Time Task: Fine Tuning the PID Controller

Activity 20: Designing Controllers for the Pressure System

Review of the Controller Design Process Control Algorithms Designing a Controller for the Pressure System: 1 Task: Experimenting With the Controller Task: Examining the Controller Performance Task: Evaluating the Controller Performance Design of a Controller for the Pressure System: 2 Task: Testing the Controller Task: Examining the Controller Performance Task: Evaluating the Controller Performance **Experimentation Results** Design of a Controller for the Pressure System: 3 Task: Testing the Controller Task: Examining the Controller Performance **Experimentation Results**

Post-test