Control Systems/PID Control (Instructor-Led Training)

Course Description

This course familiarizes the student with industrial process control systems and a variety of controllers that operate on different fundamental concepts. Each of these controllers is unique and affects the process it controls in a different manner than the others. Understanding the fundamental operational concepts behind each controller will help solve process-related problems in the field and will allow the optimization of process control systems to their specific applications.

Course Prerequisites

- GTA Web-Based Training
  - Communication and Protocols I
  - Communication and Protocols II
- GTA Instructor-Led Training
  - Basic Instruments and Control Loops

Course Objectives

Upon completion of this course, the student will have received instruction designed to assist him/her in the following:

- Describe terminology associated with control loop tuning.
- Explain the difference between dead time and time constant.
- Describe open-loop control system characteristics.
- Describe closed-loop control system characteristics.
- Describe negative and positive feedback functions.
- Operate and tune a control loop using a two-position controller.
- Operate and tune a control loop using a proportional controller.
- Operate and tune a control loop using a proportional and integral controller.
- Operate and tune a control loop using a PID controller.

Course Outline

1. Process Control Systems
    a. Fundamentals of Control Loops
    b. Variables
    c. Dynamic Response
    d. Dead Time
    e. Rise Time
    f. Time Constant
    g. Process Control System
    h. Disturbances
    i. Block Diagrams
    j. Open-loop Control Systems
    k. Closed-loop Control Systems
    l. Positive Feedback
    m. Negative Feedback
    n. Feed-forward vs Feedback
    o. Closed-loop Control Operation
    p. Self-regulating Process
    q. Stability and Instability
    r. Closed-loop Control Quality Criteria
    s. Single-capacity Process
    t. Process Gain
    u. Two-capacity Process
    v. Multiple-capacity Process
2. Modes of Control
    a. Two-position Control
        i. Open-loop Characteristics
        ii. Closed-loop Characteristics
    b. Proportional Control
        i. Open-loop Characteristics

ii. Closed-loop Characteristics

c. Proportional Plus Integral Control
   i. Open-loop Characteristics
   ii. Closed-loop Characteristics
d. Proportional Plus Integral Plus Derivative Control Mode
   i. Open-loop Characteristics
   ii. Closed-loop Characteristics

3. Control Loop Tuning
   a. Mathematical Tuning Method
      i. Testing Method
      ii. Stability Factors
   b. Controller Tuning
      i. Notch Method
      ii. Ultimate Period Method
      iii. Dampened Oscillation Method
   c. Open-loop Tuning
      i. Time Constant Method
      ii. Reaction Rate Method
   d. Analog Controllers
   e. ON/OFF
   f. Proportional
      i. Proportional Controller with Reset
      ii. Proportional Controller with Reset and Derivative
   g. Bailey 701
   h. Stand-Alone Digital Controllers
      i. Foxboro 762
   i. General Information
   j. Display and Keypad Functions
   k. Cabling, Twisted-Pair, Coaxial, and Fiber Optic
   l. Cable Installation Guidelines

Recommended Resources

- GTA Control Systems/PID Control Participant Guide
- GTA Control Systems/PID Control Instructor Presentation.
- Internet sites related to industrial control systems.
- Textbooks or other publications related to industrial control systems.