



**Chemical, Mechanical Engineering**



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# Course: Process Instrumentation: Process Control & Loop Tuning

| Code | City                     | hotel              | Start      | End        | price  | Hours |
|------|--------------------------|--------------------|------------|------------|--------|-------|
| 553  | Singapore<br>(Singapore) | Hotel Meeting Room | 2024-05-06 | 2024-05-10 | 6450 € | 25    |

## Introduction

Although the subject of many hundreds of articles, books, and courses, the basic elements of automatic process control are still widely misunderstood. Worse, the majority of control systems are misapplied. Research carried out by ISA and other bodies indicates that up to 75% of all loops will oscillate when operated in automatic.

This workshop, Process Instrumentation: Process Control and Loop Tuning, is designed to provide engineers and technicians with the basic theoretical and practical understanding of the process loop and how this can be applied to optimize process control in terms of quality, safety, flexibility and costs.

## Personal impact

On successful completion of this workshop delegates will be able to:

- understand the fundamentals of Process Control
- analyze such problems as valve hysteresis, stiction and non linearities
- fully appreciate the effects of proportional, integral and derivative control
- correctly apply both open and closed Loop Tuning according to Ziegler Nichols
- apply Lambda Tuning
- realize the effects of filtering on loop performance
- value the effect of valve sizing on control loop performance
- recognize the effect of different control algorithms on loop tuning performance
- understand cascade and feedforward control
- identify and correct problems with process dead time

## Organisational impact

Following the training and development experience provided by this workshop, participants will return to their organizations equipped with new skills and knowledge that will enable them to understand, analyse, and optimize automatic control when applied to a closed loop industrial control system.

By leveraging these skills your enterprise can expect an improvement in overall productivity, safety, and flexibility,



coupled with a reduction in costs, through the ability to analyze problems and successfully tune PID loops.

## Workshop objectives

**Designed for both novice and experienced engineers and technicians, this workshop provides an insight into modern closed loop control practices through an in-depth investigation into the four basic elements of any control system:**

- the process;
- the transducer (sensing element plus transmitter);
- the final control element; and
- the controller.

**Throughout the workshop, participants will learn through active participation using exercises, questionnaires, and practical simulation sessions covering:**

- process reaction
- tuning methods
- diagnostic tools
- affect of different algorithms

## Who Should Attend ?

**\* Professionals involved in designing, selecting, sizing, specifying, installing, testing, operating and maintaining process instrumentation and control systems**

- Automation Engineers
- Chemical Engineers
- Consulting Engineers
- Design Engineers
- Electrical Engineers
- Electricians
- Installation and Maintenance Technicians
- Instrument and Process Control Engineers and Technicians
- Instrument Fitters
- Maintenance Engineers
- Mechanical Engineers and Technicians
- Operations Engineers
- Process Engineers
- Process Operators
- Production Managers
- Project Managers
- System Integrators
- Professionals with little to moderate production facility design and/or operations background



- Other professionals who want a better understanding of the subject matter

## What you will learn

- Understand the fundamentals of Process Control
- Analyze such problems as valve hysteresis, stiction and non linearities
- Fully understand the effects of proportional, integral and derivative control
- Be able to apply both open and closed Loop Tuning according to Ziegler Nichols
- Be able to apply Lambda Tuning
- Understand the effects of filtering on loop performance
- Know the effect of valve size on control loop performance
- Recognize the effect of different control algorithms on loop tuning performance
- Understand cascade and feedforward control
- Be able to identify and correct problems with process dead time

## COURSE OUTLINE

### **Basic process considerations**

- Definition of terms
- Process lag, capacitance and resistance
- Process reaction curve
- 1st and 2nd order reactions

### **Process measurement**

- Instrumentation cabling
- Do's and don'ts
- Filtering
- Aliasing
- Reaction masking
- Sensor placement
- Correct PV
- Effect of span

### **Final control element**

- Choked flow
- Pressure recovery
- Flashing and cavitation
- Valve construction
- Valve characteristics
- Inherent



- Profiling
- Installed
- Cavitation control
- Actuators
- Diaphragm
- Cylinder
- Electric
- Valve positioners
- Deadband and hysteresis
- Stick slip

### **Fundamentals of Process Control**

- ON/OFF control
- Proportional control
- Proportional band vs. proportional gain
- Proportional offset
- Reset
- Integral action
- Integral windup
- Stability
- Bode plot
- Nyquist plot
- Derivative action
- PID control
- Control algorithms
- Load disturbances and offset
- Speed, stability and robustness

### **Fundamentals of Tuning**

- Basic principles
- Open loop reaction curve method (Ziegler-Nichols)
- Default and typical settings
- Closed loop continuous cycling method (Ziegler-Nichols)
- Lambda tuning
- Fine tuning
- Tuning according to Pessen
- Tuning for different applications

### **Automated tuning systems**

- Self tuning loops



- Adaptive control
- Practical Session

### **Advanced control algorithms**

- Cascade systems
- Feedforward and combined systems
- Ratio control
- Adaptive control systems
- Dead time compensation



**The Scandinavian Academy employs modern methods in training and skills development, enhancing the efficiency of human resource development. We follow these practices:**

- **Theoretical Lectures:**
  - We deliver knowledge through advanced presentations such as PowerPoint and visual materials, including videos and short films.
- **Scientific Assessment:**
  - We evaluate trainees skills before and after the course to ensure their progress.
- **Brainstorming and Interaction:**
  - We encourage active participation through brainstorming sessions and applying concepts through role play.
- **Practical Cases:**
  - We provide practical cases that align with the scientific content and the participants specific needs.
- **Examinations:**
  - Tests are conducted at the end of the program to assess knowledge retention.
- **Educational Materials:**
  - We provide both printed and digital scientific and practical materials to participants.
- **Attendance and Final Result Reports:**
  - We prepare detailed attendance reports for participants and offer a comprehensive program evaluation.
- **Professionals and Experts:**
  - The programs scientific content is prepared by the best professors and trainers in various fields.
- **Professional Completion Certificate:**
  - Participants receive a professional completion certificate issued by the Scandinavian Academy for Training and Development in the Kingdom of Sweden, with the option for international authentication.
- **Program Timings:**
  - Training programs are held from 10:00 AM to 2:00 PM and include buffet sessions for light meals during lectures.