Mechanical Engineering

Advanced Control Systems for Mechanical Processes

Course Introduction

Advanced control systems are essential for improving the efficiency, reliability, and precision of mechanical processes in industries such as manufacturing, automotive, and energy. These systems ensure that machines and processes operate within desired parameters, reducing waste, minimizing downtime, and improving product quality. With the increasing complexity of mechanical systems, understanding advanced control techniques is vital to maintain competitive advantage and meet operational goals. Mastering control systems can optimize energy usage, enhance automation, and support real-time decision-making. This training program will equip participants with the necessary tools and knowledge to design, analyze, and implement advanced control systems for mechanical processes.

This course will focus on advanced control strategies such as PID control, model predictive control (MPC), adaptive control, and robust control. Participants will learn how to analyze and design control systems for mechanical processes, including tuning methods, stability analysis, and performance optimization. The program will cover practical applications, including process automation, fault detection, and optimization in mechanical systems.

Target Audience

This course is designed for mechanical engineers, control system specialists, and automation professionals working with advanced control systems in mechanical processes.

Learning Objectives

- Understand advanced control strategies such as PID, MPC, adaptive, and robust control.
- Learn how to design and tune control systems for mechanical processes to optimize performance.
- Gain skills in modeling systems for Model Predictive Control and handling constraints.

- Explore adaptive and robust control methods for dynamic and uncertain mechanical systems.
- Develop the ability to apply control system simulation, fault detection, and optimization techniques in real-world applications.

Course Outline

- **01 DAY ONE**

  Introduction to Advanced Control Systems for Mechanical Processes

  - Overview of control systems and their role in mechanical processes
  - Key control strategies: feedback, feedforward, and hybrid control
  - Importance of control systems in automation and process optimization
  - Types of control systems: open-loop vs closed-loop systems
  - Components of a control system: sensors, actuators, controllers
  - Stability and performance measures in control systems

- **02 DAY TWO**

  PID Control and Tuning Methods

  - Understanding Proportional-Integral-Derivative (PID) control
  - How PID control works in mechanical processes
  - Tuning PID controllers: methods and challenges
  - Common techniques for PID tuning (Ziegler-Nichols, Cohen-Coon)
  - Practical applications of PID control in mechanical systems

  Advanced PID control strategies for non-linear systems

- **03 DAY THREE**

  Model Predictive Control (MPC) and Optimization Techniques

  - Introduction to Model Predictive Control (MPC)
  - How MPC works and its advantages over traditional control methods
  - System modeling for MPC and prediction horizon
  - Constraints handling in MPC
  - Optimization techniques in mechanical control systems
  - Applications of MPC in process control and energy optimization

- **04 DAY FOUR**

Adaptive Control and Robust Control Strategies

◦ Introduction to adaptive control and its need for dynamic systems

◦ Types of adaptive control: model reference, self-tuning regulators

◦ Robust control: definition, importance, and methods

◦ Designing robust controllers for uncertain mechanical systems

◦ Stability analysis in adaptive and robust control systems

◦ Applications of adaptive and robust control in mechanical systems

• **05 DAY FIVE**

Control System Simulation, Fault Detection, and Advanced Applications

◦ Control system simulation techniques and tools

◦ Fault detection and diagnosis in mechanical processes

◦ Advanced control strategies for fault tolerance and system reliability

◦ Control system integration with industrial automation systems

◦ Real-world applications of advanced control systems in HVAC, automotive, and robotics

◦ Optimization of energy use in control systems for mechanical processes

Confirmed Sessions

FROM	TO	DURATION	FEES	LOCATION
June 30, 2025	July 4, 2025	5 days	4950.00 $	England - London
Aug. 25, 2025	Aug. 29, 2025	5 days	4250.00 $	UAE - Dubai
Dec. 14, 2025	Dec. 18, 2025	5 days	4250.00 $	Qatar - El Doha