
Course Title : Process Dynamics and Control

- **Aim:**

Successful operation of chemical processes, from startup to shutdown, is hinged upon a proper control system. This course aims to familiarize the students with basic concepts on process control, including common control systems and enable them to analyze the performance and stability of such systems.

- **Syllabus:**

- ✓ Introduction: the importance of process control with real-life examples; basic definitions and concepts
- ✓ Dynamic modeling using mass and energy conservation laws and resulting ordinary-differential equations; dynamic behavior of simple processes
- ✓ Laplace transform: definitions; Laplace transform of simple functions; solving ordinary-differential equations using Laplace transform; process examples; dynamic response of processes using Laplace transform; linearization of nonlinear models
- ✓ Behavior of first- and second-order systems; response to common input changes (step, ramp, sinusoidal)
- ✓ Feedback control: related concepts, on/off control, modes of PID controller and their characteristics
- ✓ PID controllers: common algorithms; modifications for improved performance (e.g., two degrees of freedom); reset windup and ways to mitigate it
- ✓ Control system instrumentation: sensors, transmitters, and transducers, dynamic measurement errors, final control element, valve characteristics and dynamics
- ✓ Frequency response analysis: frequency response of transfer functions, Nyquist diagrams, Bode diagram and its application to stability analysis
- ✓ Feedforward and ratio control: applications, ratio controllers, design of feedforward controllers, combined feedback-feedforward control
- ✓ Enhanced control loops: cascade control, selective (override) and split-range control and their applications, time delay compensation
- ✓ Control strategies in multivariate systems: process examples, degrees of freedom analysis, selection of measured, controlled, and manipulated variables
- ✓ Safety and control: layers of protection, safety instrumented systems, alarms, abnormal event detection

- **Reading Resources**

Dale E. Seborg, Duncan A. Mellichamp, Thomas F. Edgar, Francis J. Doyle III. Process Dynamics and Control, 3rd Edition. John Wiley & Sons, Inc. 2010