Course Title:

Industrial Processes Control

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Ref.:

1. W. Y. Svrcek, D. P. Mahoney and B. R. Young, *A Real-Time Approach to Process Control*, John Wiley & Sons, 2006. (ISBN: 978-0-470-02533-8)
2. J. Mikles, M. Fikar, *Process Modelling, Identification, and Control*, Springer, New York, 2007. (ISBN 978-3-540-71969-4)

Syllabus:

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| 1. Introduction to Process Control
* Introduction
* Topics in Process Control
* An Example of Process Control
* Process
* Steady-State
* The Concept of Sensitivity
* Process Control
* Dynamical Properties of the Process
* Feedback Process Control
* Transient Performance of Feedback Control
1. Introduction to Project Design
* Project Design Inputs
* P&ID
* Task Description
* I/O List
* SLD
* Automation Project Design Procedure
* Creating I/O Diagram
* Defining Logic Blocks
1. Mathematical Modeling of Processes
* General Principles of Modeling
* Examples of Dynamic Mathematical Models
* Liquid Storage Systems
* Heat Transfer Processes
* Mass Transfer Processes
* Chemical and Biochemical Reactors
* General Process Models
* Linearization
* Systems, Classification of Systems
* Control Concepts
* Control Objectives and Benefits
* Formulate & Solve Dynamic Models
* Numerical Solution Of ODEs
* Qualitative Dynamic Responses
* Empirical Model Identification
1. Discrete-Time Process Models
* Computer Controlled and Sampled Data Systems
* Discrete-Time Feedback Systems (Control Performance)
* Examples of Discrete-Time Process Models
* Discrete-Time Tank Model
* Discrete-Time Model of Two Tanks in Series
* Steady-State Discrete-Time Model of Heat Exchangers in Series 1session
1. Dynamical Behavior of Processes
* Time Responses of Linear Systems to Unit Impulse and Unit Step
* Unit Impulse Response
* Unit Step Response
* Computer Simulations
* The Euler Method
* The Runge-Kutta method
* Runge-Kutta Method for a System of Differential Equations
* Time Responses of Liquid Storage Systems
* Time Responses of CSTR
* Frequency Analysis
* Response of the Heat Exchanger to Sinusoidal Input Signal
* Definition of Frequency Responses
 | * Frequency Characteristics of a First Order System
* Frequency Characteristics of a Second Order System
* Frequency Characteristics of an Integrator
* Frequency Characteristics of Systems in a Series
* Statistical Characteristics of Dynamic Systems
* Fundamentals of Probability Theory
* Random Variables
* Stochastic Processes
* White Noise
* Response of a Linear System to Stochastic Input
* Frequency Domain Analysis of a Linear System with Stochastic Input
1. Process Identification and Approximation
* Introduction
* Models of Linear Dynamic Systems
* Identification from Step Responses
* First Order System
* Under-damped Second Order System
* System of a Higher Order
* Least Squares Methods
* Recursive Least Squares Method
* Modifications of Recursive Least Squares
* Identification of a Continuous-time Transfer Function
1. Feedback Control
* Process Control Objectives
* PID Controller Modes
* PID Controller Tuning
* Frequency Response
* Stability Analysis
* Control Performance
* Digital Control Implementation
1. Classical Control Enhancements
* Cascade Control
* Feed-Forward Control
* Control Of Non-Linear Processes
* Inferential Control
* Level and Inventory Control
1. Common control loops
* Flow loops
* Liquid pressure loops
* Liquid level control
* Gas pressure loops
* Temperature control loops
* Pump control
* Compressor control
* Boiler control 2session
1. Plant-wide control
* Short-term versus long-term control focus
* Cascaded units
* Recycle streams
* General considerations for plant-wide control 1session
1. Process Control Design
* Multivariable Control Modeling & Interaction
* Control Design Method
* Control Design Tutorial 2session
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Grading:

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| 1. Homework 20 %
2. Quiz 5%
3. Final Project 20 %
4. Paper Review 10 %
 | 1. Midterm Exam 20 %
2. Final Exam 25 %
3. Regular Attendance +5%
4. Participation +5%
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