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 |

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% |