PTFE 4761 **INDUSTRIAL CONTROLS AND MANUFACTURING**
Credit: 2-3-3

Course Coordinator: **Dr. Dong Yao**

Prerequisites: ECE 3710 Circuits & Electronics

Catalog Description: Introduction to industrial controls and the fundamentals of manufacturing with hands-on experience based on lab projects using industry software and hardware for communications and control.

Course Learning Objectives:
1. Learn the basic working mechanisms of elementary controllers for both continuous and discrete processes.
2. Learn how to analyze control systems using mathematical tools, including Laplace transform, z-transform, and Boolean operations.
3. Gain laboratory experience on the use of industry software and hardware to control industry processes.

Textbook: E.W. Kamen, Industrial Controls and Manufacturing, Academic Press, 1999.

Topical Outline of Lectures:
1. Manufacturing fundamentals
2. Laplace transform and its use in control
3. Modeling and control of continuous-variable processes
4. Z-transform and its use in digital control
5. Predictive, adaptive, and neural net controllers
6. Boolean operations and its use in discrete logic control
7. Ladder logic diagrams and programmable logic controllers
8. Manufacturing systems
9. Production systems
10. Equipment interfacing and communications

Course Outcomes: Specifically, at the end of the course the students will be able to:
1. Describe the basic working mechanisms of common controllers, including PIs, PIDs, PLCs, and predicative and adaptive controllers. [1]
2. Analyze control systems using mathematical tools, including Laplace transform, z-transform, and Boolean operations. [1]
3. Design and conduct experiments, as well as to analyze and interpret data. [2]
4. Apply knowledge of industrial control to solve polymer/fiber engineering problems. [1]
5. Function effectively in teamwork. [6]

* Numbers in Brackets refer to PFE Program Outcomes to which the Course Outcomes relate.

Topical Outline of Course

Basic System Properties
Time Invariance, Linearity, Causality, Finite-Dimensionality

Laplace Transform
Definition
Common Pairs
Properties
Inverse Laplace Transform

Transfer Function Representation
Block Diagrams
Stability
Routh-Hurwitz Stability Test
Transient Response
Frequency Response including Bode Plots

Controls
Introduction to Feedback Control
Tracking Control
Root Locus
Application to Control System Design

Discrete - Time Systems
Z-Transform
Transfer Function Representation
Stability
Discretization
Design of Digital Controllers

State Representation
State Model
Solution of State Equations
Discrete-Time Systems
Equivalent State Representation
Discretization of State Model