THE OHIO STATE UNIVERSITY
COLLEGE OF ENGINEERING

Theory and Applications of Feedback Control

MECHENG 5372

Credit Hours:
3.00

Course Levels:
Undergraduate (1000-5000 level)
Graduate (5000-8000 level)

Course Components:
Lecture

Course Description:
Introduction to multi-domain (mechanical, thermal, fluid, electrical, electronic, electro-mechanical) system design, dynamic modeling, and control system design and analysis techniques.

Prerequisites and Co-requisites:
Prereq: 3360 or 3361, or Grad standing in MechEng, or permission of instructor.

Course Goals / Objectives:
- Understand the principle of operation of multi-domain systems which incorporate a variety of operating principles and functions
- Develop mathematical models for mechatronic systems
- Be able to formulate these models in the time or frequency domain
- Understand the operation of auxiliary components such as filters, A/D and D/A converters, microcontrollers, programmable logic controllers, etc.
- Be able to select actuators, sensors and auxiliary components, and integrate them to design a mechatronic system
- Understand the relationship between control system performance specifications and controller design procedures
- Perform cascade and feedback compensator designs for linear systems
- Design state feedback controllers and state observers/estimators
- Design Smith-Predictor controllers for time delayed systems
- Analyze the stability of nonlinear control systems approximately
- Use both graphical and analytical approaches (Matlab/Simulink) for control system analysis and design

Course Topics:

- Energy conversion in multi-domain systems (review)
- Actuators: operating principles and selection criteria (electromagnetic, hydraulic, pneumatic, smart materials)
- Mechanisms for motion transmission (gears, levers, etc.)
- Sensors: operating principles and selection criteria (motion, force, temperature, etc.)
- System response of mechatronic systems (transform domain)
- D/A and A/D conversion; logic operators; filtering
- Mechatronic system case studies: analysis and design
- Mid-Term exam
- Frequency Controller Design, Lead and Lag Compensation
- State Space Representation
- Controllability and Observability
- State Space Controller Design
- State Space Observer Design
- Observer-based Feedback Controller Design
- Control of Systems with Time Delay, Smith Regulator
- Nonlinear Systems, Linearization based control
- Mechatronic system case studies: control design

Designation:

Elective