Syllabus

Course No:  ECE 4470
Title:  Control Systems 1
Credits:  4

WSU Catalog Description:

Prereq: ECE 4330. Open only to students enrolled in professional Engineering programs. System representations; feedback characteristics; time-domain characteristics; Routh-Hurwitz; Root Locus Plots; Nyquist criteria, Bode plots and Nichols charts; series compensation.

Instructor:  Le Yi Wang, Professor of Electrical and Computer Engineering.

Office Hours:  Tuesdays, 1:30 – 2:30 PM, Room 3135, Engg. Bldg.

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Goals:  To develop competence in analysis, design, and evaluation of basic control systems.

Learning Objectives:  At the end of this course, students will be able to:

1. Derive the models for basic physical systems
2. Analyze the steady-state and transient behavior of basic feedback systems.
3. Determine stability and performance of feedback systems using time-domain and frequency domain analysis methods.
4. Design PID and lead-lag controllers to achieve design specifications.
5. Perform basic simulation to verify system stability and performance.


Software:  Matlab/Simulink and related toolboxes

Prerequisites by Topic:  signals, differential equations, linear systems, Fourier transform, Laplace transform.

Course Outline:
1. Introduction (Chapter 1) (Brief)
2. Mathematical Foundation (Chapter 2) (Background Material from ECE 4330)
   First Quiz:  Background Material (Chapter 2)
3. Transfer Functions and Signal Graphs (Chapter 3)
4. Modeling of Physical Systems (Chapter 4)
   Midterm 1:  Chapters 3 and 4
5. Stability of Linear Time Invariant Systems (Chapter 6)
6. Time-Domain Analysis of Control Systems (Chapter 7)
**Midterm 2:** Chapters 6 and 7
7. Root Locus Techniques (Chapter 8)
8. Frequency Domain Analysis (Chapter 9)
9. Design of Control Systems (Chapter 10)
**Final Exam:** Chapters 8, 9, and 10

**Grade Distribution:**
- Homework Assignments: 15 %
- Background Quiz: 5 %
- Midterm Exam 1: 20 %
- Midterm Exam 2: 20 %
- Project: 10 %
- Final Exam: 30 %

**Grade Curves:**
- A = 95-100, A- = 90-94, B+ = 85-89, B = 80-84, B- = 75-79,
- C+ = 70-74, C = 65-69, C- = 60-64, D = 45-59, E = 0-44

**Outcome Coverage:**

(a) *An ability to apply math, science and engineering knowledge.* The exams require direct application of mathematical, scientific, and engineering knowledge to successfully complete the course. This requires performing various linear system analysis methods, control theory in a formal manner and many supporting and follow-up calculations.

(b) *An ability to design and conduct experiments, as well as to analyze and interpret data.* Students conduct system analysis, design, simulation using Matlab and Simulink software.

(c) *An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.* Design and simulation problems require students to calculate system parameter values based on design specifications that are commonly encountered in practical systems.

(e) *Identify, formulate and solve engineering problems.* The course is oriented toward modeling and controlling physical systems that are typical and simplified from many practical systems. Students must be able to identify the system, formulate a system model, and design a valid control system for the application.

(h) The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context. Students taking the course will realize the broad applicability of control theory to electrical and other physical domains.

**Cheating Policy and Penalty for Cheating:** The students should not copy each other’s reports. During examination times no talking and passing papers or other items among the students will be allowed. The instructor will give an overall grade of F (Fail) to a student if that student is caught with any kind of cheating.
Note:
1. Please make sure that you have access to the WSU Blackboard system, and WSU emails (your WSU access ID email address) can reach you. I will use this system to inform you about the class material and schedules.
2. Homework assignments are important part of the course and are to be completed individually. They must be submitted before the end of the class on the due date. Please submit your homework in the class. Do not submit homework by email.
3. This course requires computer simulation on Matlab/Simulink. The software is available in the Engineering Computing Center and Undergraduate Library.
4. The quiz and midterm exams will be arranged in regular class meeting time. The final exam will be scheduled based on the Wayne State Exam Schedule.
5. No makeup exams will be administered. A student who misses a quiz or midterm exam due to illness or jury duty must provide written and signed proofs to the instructor.
6. Exams are open books and open notes. You can use calculators that do not include high-level computational programs (such as Matlab, Mathcad, symbolic Math software, etc). Laptop computers are NOT allowed in exams.
7. Please observe the university, college and department deadlines for withdrawing from this class. While I don’t have any interest in forcing anyone to stay in my class, I don’t make special cases for people who miss the deadlines.
8. Cheating in any form will be prosecuted according to the University regulations and will result in severe penalty, including possible exclusion from the University. It is your responsibility to protect your work from unauthorized copying. Both students who provide or receive unauthorized help on quizzes, exams and projects will be considered as cheating.