Syllabus

No: ECE 4470

Title: Control Systems 1

Credits: 4 (LCT: 4)

WSU Catalog Description:
Prereq: ECE 4330. System representations; feedback characteristics; time-domain
characteristics; signal flow graph, Routh-Hurwitz criteria; Root locus plots; Nyquist criteria, Bode
plots; PID, phase-lead and phase-lag controller design. (T)

Coordinator: Feng Lin, Professor of Electrical and Computer Engineering

Instructor: Feng Lin, Professor of Electrical and Computer Engineering
Office Hours: M, 1:30-3:20 PM and W, 10:30-11:30 AM
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Course Meeting Time: M W 03:30-05:20PM
Course Meeting Location: 0289 MANO

Goals: Understand the theory and methods for analysis and design of control systems
using classical methods. Know how to use design and simulation software such as
MATLAB.

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

1. Model basic systems
2. Draw block diagrams, signal flow graphs, state diagrams
3. Derive transfer functions of linear time-invariant systems
4. Linearize nonlinear systems
5. Determine stability of linear time-invariant systems
6. Determine steady state responses and steady state errors
7. Determine transient responses
8. Use root-locus technique to analyze systems
9. Use Nyquist criterion to analyze systems
10. Determine stability margins using Bode plots
11. Design PID, phase-lead, and phase-lag controllers using root-locus technique
12. Design phase-lead and phase-lag controllers using Bode plots

ISBN: 0-471-13476-7

Reference Texts: none
Prerequisites by Topic: (ECE 4330) (1) Electric circuits and Kirchhoff’s laws, (2) mechanical systems and Newton’s laws, (3) differential equations and their solutions, (4) Laplace transform and its properties, (5) impulse responses and convolutions.

Corequisites by Topic: none

Topics:

1. Transfer functions and signal flow graphs (2 weeks)
2. Modeling of real systems (1.5 weeks)
3. Stability of linear time-invariant systems (1.5 weeks)
4. Time-domain analysis of control systems (2 weeks)
5. Root locus technique (1.5 weeks)
6. Frequency-domain analysis of control systems (2 weeks)
7. Design of control systems (3 weeks)

Course Structure: The class meets twice a week, two hours each for total 4 credit hours.

Computer Resources: Students need to have access to computers with MATLAB software.

Laboratory Resources: none

Laboratory Policy: none

Distribution of Points: Quizzes-30%, Homework-10%, Attendance-10%, Final-30%, and Project-20%.

Grading Scale: A: 95-100; A-: 90-94, B+: 87-89; B: 83-86; B-: 80-82; C+: 77-79; C: 73-76; C-: 70-72; D: 60-69; E: 0-59

Attendance: Students are expected to attend all lectures. The most common reasons for failing this course are (1) not attending all lectures and (2) not having sufficient time spent on the course.

Homework: 3-1, 3-4, 3-7 (a,e), 3-13, 3-18, 3-22, 4-2, 4-6, 4-12, 4-16, 6-2 (b,f), 6-4, 6-11, 6-12, 7-1 (a,c), 7-3 (b,e), 7-7, 7-13, 7-22, 8-5 (b,f,j), 8-6 (a,e,m), 8-7(a,c), 8-11, 8-17, 9-3, 9-9 (b,d,h), 9-10 (b), 9-26 (b,d), 9-28, 10-3, 10-5, 10-8, 10-12, 10-13, 10-22, 10-24, 10-26, 10-27,10-38

Schedule:

- Quizzes: one week after completing Chap 4, 7, 9
- Homework due: one week after completing Chap 4, 7, 9
- Project due: Dec. 2, 2015
- Final Exam: Dec. 18, 2015 (university schedule)

The last day to withdraw from any class with a tuition refund is the end of the second week of classes. Students must initiate withdrawals from the course. All students who do not withdraw from the course will be given grades.
Makeup Exam and Makeup Assignment Policy: No make up quizzes or exams. No late assignments.

Outcome Coverage:

(a) An ability to apply math, science and engineering knowledge. The homework, project, quizzes and exams require direct applications of mathematical, scientific, and engineering knowledge to successfully complete the course.

(b) An ability to design and conduct experiments, as well as to analyze and interpret data. The homework and project require student to design, conduct simulations using MATLAB and analyze simulation data.

(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. The design in the project must be checked against real world operating limits.

(e) Identify, formulate and solve engineering problems. Students must be able to identify and model the system; analyze and solve control problems.

(g) An ability to communicate effectively. Students are required to write a comprehensive report on the project.

(k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice. Students taking the course will learn how to use control techniques and software tools such as MATLAB for solving practical control problems.

Cheating Policy and Penalty for Cheating: Cheating is defined by the University as “intentionally using or attempting to use, or intentionally providing or attempting to provide, unauthorized materials, information, or assistance in any academic exercise.” This includes any group efforts on assignments or exams unless specifically approved by the professor for that assignment/exam. Evidence of fabrication or plagiarism, as defined by the University in its brochure Academic Integrity, will also result in downgrading for the course. Students who cheat on any assignment or during any examination will be assigned a failing grade for the course.

Prepared By: Feng Lin, Professor of Electrical and Computer Engineering

Last Revised: August 28, 2015