ENME 403 – Automatic Controls, Fall 2014

Department of Mechanical Engineering

Lecture Details

Tuesday and Thursday, 5:30 pm to 6:45 pm
Performing Arts and Humanities, Room 132

Instructor

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Course Objectives

1. Use Laplace transform methods to manipulate and solve models of linear dynamic systems.
2. Analyze the stability, transient, and steady-state behavior of linear dynamic systems.
3. Design linear feedback controllers using time and frequency domain design procedures to satisfy specific performance specifications.
4. Use computer-aided analysis and design tools (Matlab and Simulink).

Textbook

Control Systems Engineering (6^{th} Edition) by Norman Nise, Wiley, 2011.
ISBN 978-0-470-54756-4.

Grading Policy

The interim and final course grades will be based on the following approximate grade weights and breakdowns:

Participation	5%
Assignments and Exercises	20%
Midterm #1	25%
Midterm #2	25%
Final Exam	25%

Participation will be self-evaluated with final grade decisions made by the professor. Assignments and exercises will be performed both in and outside class hours. Preparation, alertness, and performance in the classroom will be subjective factors used to arrive at a final grade.

Exams

Two 1-hour midterms and one 2-hour final exam will be given in this course. The content of the midterms is not cumulative, however the final exam content is cumulative. Successful completion of exams and assignments requires the use of calculators and, possibly, additional supplemental handouts. Calculators and additional required material may not be shared during examinations. No collaboration is permitted during examinations, and if violated, is subject to UMBC's Academic Integrity policy.

Assignments and Exercises

i) The assignment questions (in full) will be posted online (Blackboard course website).

ii) Four assignments and in-class exercises will be assigned, collected, and graded. You are encouraged to seek assistance from any legitimate source in understanding homework, including collaboration with other students. The written work, however, must be your own. No late submissions will be accepted.

iii) All work must be neat, legible, and contain the following at the top of the first page: printed name, student number, signature, assignment number, and due date. Your signature is your acknowledgment that you have understood and complied with the requirements of this policy statement and that you have acted honorably in the preparation of submitted work.

iv) If required: For computer work, sufficient documentation must be provided to validate and reproduce the results. Typical documentation includes the Matlab m-files or Simulink model, input and parameter data, and results. Source code and scripts should include your name and brief descriptive text. Plots must contain descriptive titles with your student name and appropriate labels.

Absences/Makeups: Class attendance is a prerequisite to success. It is your responsibility to turn in any course work when due and to obtain notes and announcements from another class member for classes you have missed. No late submissions will be accepted. If there are extenuating circumstances, see the professor prior to the due date and alternate arrangements may be made. Makeup exams must be scheduled within one week of absence, however this is your responsibility.

Collaboration Policy Collaboration of any kind or the use of references and other sources of external information on exams is forbidden unless otherwise stated in this policy or as indicated in writing on assignment cover sheets. Selective collaboration on learning assignments (homework, and in-class exercises) can often assist in the learning process. This should be done in moderation, however, since the ultimate measure of this course (and your final grade) is the level of the individual's knowledge, not the collective knowledge of all of his/her associates.

Academic Integrity By enrolling in this course, each student assumes full responsibility as a participant in UMBC's scholarly community in which everyone's academic work and behavior are held to the highest standards of honesty. Cheating, fabrication, plagiarism, and helping others to commit these acts are all forms of academic dishonesty. Academic misconduct could result in disciplinary action that may include, but is not limited to, a grade of zero on the particular work, a grade of F in the class, suspension, or dismissal. To read the full student academic conduct policy, consult the UMBC student handbook, the faculty handbook, or the UMBC policies section of the UMBC directory.

ABET Program Criteria

In addition to teaching the subject material, accreditation of the Department of Mechanical Engineering at UMBC by ABET requires the curriculum to meet certain criteria. This course is designed to provide the students with the following ABET originated concepts:

a) An ability to apply knowledge of mathematics, science, and engineering.
b) An ability to design a system, component, or process to meet desired needs.
c) An ability to function on multi-disciplinary teams.
d) An ability to identify, formulate, and solve engineering problems.
e) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Syllabus Note

Please note that this course syllabus is subject to change. The most recent version is available on the course website (Blackboard).

Fall 2014 Class Schedule

Week	Lecture Day	Topic/Event	Assigned Reading
8/25	Tuesday	No Class	N/A
	Thursday	Introduction to Course	Chapter 1
9/1	Tuesday	Laplace Transform Review Transfer Functions	Chapter 2.1 – 2.3
	Thursday	Modeling Electrical & Mechanical Systems Modeling Rotational and Systems with Gears	Chapter 2.4 – 2.7
9/8	Tuesday	Introduction to Modeling in the Time Domain State-Space Representation	Chapter 3.1 – 3.4
	Thursday	Converting a Transfer Function from State Space Converting from State Space to a Transfer Function	Chapter 3.5 – 3.6
9/15	Tuesday	Introduction to Time Response First Order Systems **Assignment #1 Due Date** [Chp. 1 – 3]	Chapter 4.1 – 4.3
	Thursday	Second Order Systems Design of Systems and Responses	Chapter 4.4 – 4.6
9/22	Tuesday	Reduction of Multiple Subsystems Block Diagrams	Chapter 5.1 – 5.3
	Thursday	Signal Flow Graphs Mason's Rule	Chapter 5.4 – 5.6
9/29	Tuesday	Introduction to Stability Routh-Hurwitz Criterion – Part 1	Chapter 6.1 – 6.3
	Thursday	Routh-Hurwitz Criterion – Part 2 Stability in State Space	Chapter 6.4 – 6.5
10/6	Tuesday	Material Practice and Review **Assignment #2 Due Date** [Chp. 4 – 6]	Chapters 1 – 6
	Thursday	**Midterm Exam #1**	Chapters 1 – 6
10/13	Tuesday	Midterm Review Steady-State Errors	Chapter 7.1 – 7.5
	Thursday	Introduction to Root Locus Root Locus Properties	Chapter 8.1 – 8.4
10/20	Tuesday	Root Locus Sketching	Chapter 8.5 – 8.8
	Thursday	Introduction to Design via Root Locus	Chapter 9.1 – 9.2
10/27	Tuesday	Lag & Lead Compensation (Root Locus)	Chapter 9.3 – 9.4
	Thursday	PID & Feedback Compensation	Chapter 9.4 – 9.5
11/3	Tuesday	Frequency Response Introduction Bode Plots **Assignment #3 Due Date** [Chp. 7 – 9]	Chapter 10.1 – 10.2
	Thursday	Nyquist Criterion	Chapter 10.3 – 10.4
11/10	Tuesday	Stability Margins Frequency Response Properties	Chapter 10.7 – 10.11
	Thursday	Lag & Lead Compensation (Frequency) – Part 1	Chapter 11.1 – 11.4
11/17	Tuesday	Lag & Lead Compensation (Frequency) – Part 2	Chapter 11.1 – 11.4
	Thursday	No Class (Free Study Day)	Chapters 7 – 11
11/24	Tuesday	Practice and Review **Assignment #4 Due Date** [Chp. 10 – 11]	Chapters 7 – 11
	Thursday	No Class (Thanksgiving)	Turkey
12/1	Tuesday	**Midterm Exam #2**	Chapters 7 – 11
	Thursday	Material Review and Exam Preparation **Assignment BONUS Due Date** [Chp. 2-11]	Chapters 1 – 11
12/8	Tuesday	No Class (Free Study Day)	Chapters 1 – 11
	Thursday	**Final Exam**	Chapters 1 – 11