Syllabus for ECE504
Analysis of Deterministic Signals and Systems
Fall 2009

Instructor: D. Richard Brown III

- Office: Atwater Kent 313
- Office Hours: By appointment (stop by or send email).
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Class Meetings

AK233, Tuesdays 6:00pm-8:45pm, Sep 8 – Dec 15, but not Nov 24.

Examination Schedule:

- Midterm: Tuesday, October 20, 6:00pm
- Comprehensive Final: Tuesday, December 15, 6:00pm

Recommended Background:

It is recommended that students taking ECE504 have previously completed undergraduate courses covering the topics of differential equations, Laplace, Fourier, and Z-transforms as well as continuous-time and discrete-time signal and system analysis, e.g. ECE2311 and ECE2312. Some familiarity with linear algebra and Matlab will also be useful.

Course Textbook:

- *Linear System Theory and Design, Third Edition,* Chi-Tsong Chen

Other Selected Textbooks:

Many of these books are available in the WPI library:

- *Linear Systems and Signals,* B.P. Lathi [TK5102.5 L29 1992]
- *State Space Analysis: An Introduction,* L.K. Timothy and B.E. Bona [QA402 T5]
- *Linear Systems,* T. Kailath [QA402 K295 1980]
- *Finite Dimensional Linear Systems,* R.W. Brockett [QA402 B68]
- *Introduction to Dynamic Systems: Theory, Models, and Applications,* D.G. Luenberger [QA402 L84]

- *Modern control theory,* William L. Brogan [QA402.3 B76 1985]
- *Linear Systems,* P.J. Antsaklis and A.M. Michel
- *Nonlinear Dynamics and Chaos,* S. Strogatz

Course Description

EE504 is a first-year graduate course on the analysis of deterministic continuous-time and discrete-time signals and systems. The topics covered in this course form a foundation for several applied disciplines including control systems, signal processing, and communication systems. The primary goals of this course are to provide an understanding of the fundamentals that govern the behavior of continuous-time and discrete-time dynamic systems and to provide the student with a sophisticated set of tools for analyzing systems. From a top-level perspective, this course addresses three core subjects: (i) mathematical description of signals and systems, (ii) qualitative and quantitative analysis of systems, and (iii) design/modification/control of systems to meet performance criteria. The focus of this course is primarily theoretical, but illustrative examples and computer exercises will be used to develop intuition and reinforce the core concepts.

Course Web Page and Announcements

The official web page for this course is:

`http://spinlab.wpi.edu/courses/ece504_2009/`

All handouts, including assignments, exams, and their solutions, will be available here. Course announcements will be sent via the course email distribution list: `ece504@ece.wpi.edu`

Grading, Exams, and Homework Policy

Grading for the course is on a 1000-point scale, with the points distributed as follows:

Homework assignments (11 worth 15 points each, drop lowest)	150
Midterm Exam	350
Comprehensive Final Exam	500
Total	1000

Exams are closed-book and closed-notes. If you wish, you may bring one sheet of letter-size paper with notes (in your own handwriting — no photocopies or printouts) on one or both sides. Use of calculators is prohibited during examinations.

Homework assignments are due by the end of lecture (8:45pm). A 30% late penalty will be deducted from a homework assignment turned in after class on the Tuesday it is due but before 5:00pm on Thursday. Since homework solutions will be distributed on Fridays, no homework assignments will be accepted after 5:00pm on Thursdays following the homework due date.

Tentative Course Schedule

Date	Topic	Reference
Sep 8	Course introduction, notation, examples, qualitative properties of systems.	Chen chapters 1–2
Sep 15	State space representation of systems. Linear algebra.	Chen chapters 2–3.
Sep 22	Linearization of nonlinear systems. Impulse and frequency response. Relationships between representations. More linear algebra.	Chen chapters 2–3
Sep 29	Solution of LTI and LTV state-space equations.	Chen chapter 4
Oct 6	Computation of $\boldsymbol{A}^k$ and $e^{\boldsymbol{A}t}$ for diagonalizable $\boldsymbol{A}$	Chen chapter 4
Oct 13	Computation of $\boldsymbol{A}^k$ and $e^{\boldsymbol{A}t}$ for undiagonalizable $\boldsymbol{A}$. Jordan canonical form, companion form, Cayley-Hamilton theorem and applications. Review.	Chen chapter 4
Oct 20	Midterm exam	Chen chapters 1–4
Oct 27	BIBO and zero-input stability of LTI systems.	Chen chapter 5
Nov 3	Lyapunov stability and stability of LTV systems.	Chen chapter 5
Nov 10	Controllability, reachability, and observability	Chen chapter 6
Nov 17	Realization of transfer functions. Minimal realizations and relationships to controllability and observability.	Chen chapter 7
Nov 24	NO CLASS — THANKSGIVING BREAK	
Dec 1	State feeback with perfect state knowledge. Design of a state observer/estimator.	Chen chapter 8
Dec 8	Pole placement and model matching via state feedback.	Chen chapter 9
Dec 15	Comprehensive final exam	Chen chapters 1–9

END OF SYLLABUS