

Syllabus for ECE531
Analysis of Deterministic Signals and Systems
Spring 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

AK219, Thursdays 6:00pm-8:50pm, Jan 22 – Apr 30.

Examination Schedule:

- Midterm: Thursday, March 5, 6:00pm
- Final: Thursday, April 23, 6:00pm

Recommended Background:

Students taking ECE531 should have a background in probability and random processes (ECE502 or equivalent; may be taken concurrently) and a familiarity with dynamic systems (ECE504 or equivalent). Some familiarity with linear algebra and Matlab may also be useful.

Course Textbook:

- *An Introduction to Signal Detection and Estimation*, Second Edition, by H. Vincent Poor

Other Potentially Useful References:

There are many potentially useful textbooks on detection and estimation theory. Here are some that I have found helpful.

- *Fundamentals of Statistical Signal Processing Volume I: Estimation Theory*, S. Kay
- *Fundamentals of Statistical Signal Processing Volume II: Detection Theory*, S. Kay
- *Detection of Signals in Noise*, Whalen.
- *Random Signals: Detection, Estimation, and Data Analysis*, Shanmugan.
- *Introduction to Nonparametric Detection with Applications*, Gibson and Melsa.

- *Testings Statistical Hypotheses*, Lehmann.
- *Theory of Point Estimation*, Lehmann.
- *Linear Estimation*, Kailath, Sayed, Hassibi
- *Quickest Detection*, Poor and Hadjiliadis.

Course Description

The subject of signal detection and estimation is concerned with the processing of information-bearing signals for the purpose of making inferences about the information that they contain. The purpose of this course is to provide an introduction to the fundamental theoretical principles underlying the development and analysis of techniques for such processing. The level of this course is suitable for research students in communications, control, signal processing, and related areas.

Course Web Page and Announcements

The official web page for this course is:

<http://spinlab.wpi.edu/courses/ece531/>

All handouts, including assignments, exams, and their solutions, will be available here. Course announcements will be sent via the course email distribution list: ece531@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 (10 worth 20 points each, drop two lowest)	160
Midterm Exam	340
Comprehensive Final Exam	500
Total	1000

Exams are closed-book and closed-notes. If you wish, you may bring one sheet of paper with notes (in your own handwriting — no photocopies or printouts) on one or both sides to the midterm examination. Two sheets of paper with notes may be brought to the final examination. Use of calculators is prohibited during examinations.

Homework assignments are due by the end of lecture (8:50pm). A 20% late penalty will be deducted from a homework assignment turned in after class on the Thursday it is due but before 5:00pm on the subsequent Friday. A 40% late penalty will be deducted from a homework assignment turned in after class on the Thursday it is due but before 5:00pm on the following Monday. Since homework solutions will be posted on Mondays, no homework assignments will be accepted after 5:00pm on Mondays following the homework due date.

Tentative Course Schedule

Date	Topic	Reference
Jan 22	Course introduction, notation, review of joint and conditional probability concepts, review of random variables	Poor Ch. I
Jan 29	A mathematical model for hypothesis testing, Bayesian hypothesis testing	Poor Ch. II
Feb 5	Minimax and Neyman-Pearson hypothesis testing	Poor Ch. II
Feb 12	Composite hypothesis testing	Poor Ch. II
Feb 19	Detection of signals in noise	Poor Ch. III
Feb 26	Sequential detection and quickest detection	Poor Ch. III
Mar 5	Midterm exam.	Poor Ch. II and III
Mar 12	Bayesian estimation and introduction to nonrandom parameter estimation	Poor Ch. IV
Mar 19	Nonrandom parameter estimation	Poor Ch. IV
Mar 26	The Fisher Information matrix and the Cramer-Rao lower bound	Poor Ch. IV
Apr 2	Maximum likelihood estimation	Poor Ch. IV
Apr 9	Dynamic parameter estimation and the Kalman-Bucy filter	Poor Ch. V
Apr 16	Linear signal estimation and causal Wiener-Kolmogorov filtering	Poor Ch. V
Apr 23	Comprehensive final exam	Poor Ch. II-V
Apr 30	Topics TBD.	