EEE 242 STATISTICAL SIGNAL PROCESSING

Elective Graduate Course **Date:** 2/24/2007

Course Area: Control/Robotics

Course Coordinator: Mahlon D. Heller, Ph.D.

Catalog Description: Introduces the student to modern statistical approaches for solving electronic system noise problems. A few of the topics covered are: Stochastic processes, Wiener and Kalman filters, linear prediction, lattice predictors and singular-value decomposition. 3 units.

Prerequisites: BS Degree or permission of instructor

Text: R. G. BROWN & P. Y.C. HWANG, INTRODUCTION TO RANDOM SIGNALS & APPLIED KALMAN FILTERING, 3rd EDITION, Wiley, 1996.

Additional Resources: Student Version of MATLAB (Version 5.0 or later) or access to MATLAB. MATLAB is on the computers in the Campus Open Computer Labs.

Course Objectives:

1) For the student to gain an understanding of random and signals and their underlying statistics,

2) For the student to gain an understanding of Wiener filter theory and design discrete and continuous Wiener filters and

3) For the student to gain an understanding of Kalman Filter theory and design discrete Kalman filters.

MATLAB is used to support the above objectives. MATLAB is available on the open campus labs. The course is designed so that the student can use the "student version of MATLAB," version 5 or later. The instructor will also provide MATLAB files to assist the student. The instructor will be available to assist the student during campus office hours and via WebCT/Blackboard mail.

Expected Major Outcomes:

1) The student is expected to be able to determine the statistical properties of random signals.

2) The student is expected to be able to design a Wiener filter to filter signal noise given the statistical properties of the random process.

3) The student is expected to be able to design a discrete-time Kalman filter given the state-space model of the system to filter unwanted random signals.

4) Given a stable or unstable linear state-space system, the student is expected to be able to design a feedback controller, to stabilize the system using pole-placement techniques.

Prerequisites by Topic:

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Basic Statistics	Random Processes
Laplace Transforms	Wiener Filter Design
Basic State-space Mathematics	Kalman Filters

Topics Covered: Mathematical descriptions of systems, linear algebra, state-space solutions and realizations, stability analysis of linear systems, controllability and observability of state-variables, minimal state realizations, and state feedback and state estimators.

Evaluation: Online chapter quizzes (10%), midterm exam (45%) and final exam (45%).

Course Outline/Schedule

Week	*Topic*	*Text Reference*
1	PROBABILITY AND RANDOM VARIABLES	
	CHAPTER 1 QUIZ	
3	MATHEMATICAL DESCRIPTION OF RANDOM SIGNALS.	
	CHAPTER 2 QUIZ	
5	RESPONSE OF LINEAR SYSTEMS TO RANDOM INPUTS.	
	CHAPTER 3 QUIZ	
7	WIENER FILTERING.	
	CHAPTER 4 QUIZ	
8	MIDTERM EXAM OVER CHAPTERS 1 THROUGH 4	
9	THE DISCRETE KALMAN FILTER, STATE-SPACE MODELING, & SIMULATION	
	CHAPTER 5 QUIZ	
12	PREDICTION, APPLICATIONS, & MORE DISCRETE KALMAN FILTERING.	
	CHAPTER 6 QUIZ	

14	9. LINEARIZATION AND ADDITIONAL INTERMEDIATE-LEVEL TOPICS ON APPLIED KALMAN FILTERING.	
	CHAPTER 7 QUIZ	
16	FINAL EXAM OVER CHAPTERS 5 THROUGH 9	