ECE 514 Course Information

Course Learning Objectives

By the time the students successfully complete the course, they should be able to:

1. Solve problems using the tools of probability theory, random variables, and stochastic processes.
2. Formulate and analyze probabilistic models and methods for electrical and computer engineering problems.
3. Make precise statements about probabilistic models.

Each module will have its own learning objectives related to these course objectives.

The ultimate goal of this course is to *change the way you think*.

Brief Course Description

- Probability theory
- Random variables
- Stochastic processes
- Examples from various applications.

Textbook

- John A. Gubner, *Probability and Random Processes for Electrical and Computer Engineers (Links to an external site.)*, Cambridge University Press, 2006. ISBN: 9780521864701.
- There is no requirement to purchase your textbook from any particular vendor or in any particular format (e-book, softcover, hardcover, etc.). As long as it works well for you, it's fine.

Prerequisites

- Undergraduate signals and systems.
- Undergraduate probability and statistics.

Workload

Because this is a three-credit course, the standard expectation is that you spend 10-12 hours total on average each week.

The modules, readings, quizzes, homework sets, and tests are designed so that the workload is spread out throughout the semester in a manageable way. You will have ample time to complete them because the available time is generous. Nonetheless, some students have reported that this is a challenging course because it requires a lot of thinking. (Sorry, but it's good for you!)

Grading

- Homework and Quizzes: 10%
- Tests: 90%

Assessment Approach

The quizzes, homework sets, and tests are all designed to help you learn and master the material in this course. There are two types of homework questions:

1. Questions that ask you to perform straightforward tasks related to the material. These are designed to ensure that you have basic experience in working with the types of problems involved. They are typically easy to answer.
2. Questions that ask you to perform challenging tasks. They are designed to prompt you to think hard about the material and synthesize integrative knowledge. These questions are typically are more difficult to answer than the first type (above), take more thinking time, and will assess your mastery of the material. Moreover, they have high pedagogical value because they prompt you to go through the process of consolidating your thinking, knowledge, and skills. They are also designed to ensure that you will learn something new by the time you complete them.

The test questions will focus mainly on the second type because they are meant to consolidate your learning and to test your mastery of the subject matter. The bulk of your final grade is based on the tests (almost 30% each).

Examples of Applications

- Data sciences
- Machine learning
- Probabilistic robotics
- Communication systems
- Signal and image processing
- Internet and other stochastic networks
- Computer performance modeling
- Information theory
- Biological processes

- Quantum physics
- Manufacturing systems
- Finance and investment planning
- Economic models
- Decision making under uncertainty
- Statistical analysis

ECE 514 Course Schedule

Week	Date	Module	Assignments
1	8/20, 22	Start here: Introduction and Overview Module 1: Background on Random Processes	Homework 1
2	8/27, 29	Module 2: Probability Models. Module 3: Sigma Algebras	Homework 2 Quiz on sigma-algebras (in lieu of Homework 3)
3	9/3, 5	Module 4: Probability Measures	Homework 4
4	9/10, 12	Module 5: Random Variables	Homework 5
5	9/17, 19	Module 6: Expectations	Homework 6
6	9/24, 26	Module 7: Probability Approximations and Bounds	Homework 7

7	10/1, 3	Module 8: Conditional Distributions and Expectations	Test 1 (Cumulative up to Module 6) Homework 8
8	10/8, 10	Module 9: Statistical Inference	Homework 9
9	10/15, 17	Module 10: Random Vectors	Homework 10
10	10/22, 24	Module 11: Gaussian Random Vectors Module 12: Infinite-Dimensional Random Vectors	Test 2 (Cumulative up to Module 9) Homework 11 No Homework 12
11	10/29, 31	Module 13: Random Processes Module 14: Second-Order Random Processes	Homework 13 Homework 14
12	11/5, 7	Module 15: Continuous-Time Filtering	Homework 15
13	11/12, 14	Module 16: Advanced Topic - Ergodicity	
14	11/19, 21	Module 16: Advanced Topic - Ergodicity	Test 3 (Cumulative up to Module 15)
15	11/26, 28	*Thanksgiving Break*	*Celebrate*
16	12/3, 5	Module 16: Advanced Topic - Radar	