416mcd2025

Master Course Description for EE-416 (ABET sheet)

Title: Random Signals for Communications and Signal Processing

Credits: 4 (4 lecture)

UW Course Catalog Description

Coordinator: James A. Ritcey, Professor, Electrical and Computer Engineering

Goals: To teach modern techniques of applied probability and statistical signal processing and apply these techniques to communications and signal processing.

Learning Objectives: At the end of this course, students will be able to:

1. *Understand and apply* the fundamental models of probability as they arise in communications, networking, and signal processing.
2. *Evaluate* the basic models in applied probability, both in univariate and multivariate settings.
3. *Analyze* randomness and uncertainty in systems using probablistic methods.
4. *Generate* random variables to use in signal processing systems.
5. *Design* signal processing software to analyze random data.
6. *Communicate* conclusions and results in project final reports.

Textbook: Charles Therrien and Murali Tummala, *Probability and Random Processes for Electrical and Computer Engineers, 2nd Ed.* CRC Press, 2012, ISBN-13: 978-1439826980, ISBN-10: 1439826986

Reference Texts:

1. Leon-Garcia, Alberto, *Probability, Statistics, and Random Processes for Electrical Engineering.* Pearson, 2017.

Prerequisites by Topic:

1. Statistics (as covered in EE391 or STAT390 or INDE315)
2. Discrete time signal processing (as covered in EE-242)
3. MATLAB or Python programming (as covered in EE-241)

Topics:

1. Fundamental Models of Probability [1 week]
2. Discrete Random Variables and their distributions[1 weeks]
3. Continous Random Vaiables and their distributions[2 weeks]
4. Jointly Distributed Continuous Random Variables [2 weeks]

5. The Multivariate Gaussian Distributions [1 week]
6. Stochastic Processes [2 weeks]
7. Applications to Statisical Signal Processing for communications [1 week]

Course Structure: The class meets for two lectures a week, each consisting of 100-minutes. Homework is assigned weekly for a total of 8 assignments over the quarter. A group final project, which includes significant programming and analysis of data, is assigned during the last two weeks of the quarter. There is one midterm exam and one final exam.

Computer Resources: MATLAB or Python may be used for general purpose analysis. This includes both computation of probability models and some statistical signal processing. MATLAB is available in all of the general purpose computing laboratories in the ECE Department.

Laboratory Resources: None required.

Laboratory Structure: Not applicable.

Grading: Final Project (30%), Homework (20%), Midterm (25%), Final Exam (25%)

ABET Student Outcome Coverage: This course addresses the following outcomes:

H = high relevance, M = medium relevance, L = low relevance to course.

(1) *An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics* **(H)** The lectures, homework and final project deals with the application of probability to circuit theory to electronic system analysis and design. Most of the first half of the couse is applied mathematics. The homework assignments and final project involve a large component of solving engineering problems. The final design projects are open-ended and additionally require the students to identify and formulate the principle issues associated with the engineering problems.

(2) *An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors* **(M)** The final project challenges the students to design and simulate a statistical signal processing system for communications. The exact application may vary with the offering. Recent examples have included brain-wave signals, interference rejection, machine learning, prediction and smoothing, and demodulation of CDMA spread spectrum signals.

(3) *An ability to communicate effectively with a range of audiences* **(M)** Design project reports are required to be specifically styled and formatted. The grading includes components for readability and formatting, as well as coverage and correctness.

(4) *An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives* **(M)** The final project is addressed by teams of two or more students who

must self-organize and divide up the work appropriately. The same grade is assigned to both students.

(5) *An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions* **(H)** Students are asked repeatedly to analyze and interpret probability models. Monte Carlo simulation techniques are used to solve difficult problems not amenable to analysis and as a substitute for physical experiments. Datasets are downloaded and used to draw inferences.

(6) *An ability to acquire and apply new knowledge as needed, using appropriate learning strategies* **(L)** Each week class time is spent discussing topics of current interest that require the use of probablity and statistics. Students are asked to discuss how to address these larger problems, by identifying the available tools and techniques.

Prepared By: James A. Ritcey

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