ECE600 Random Variables and Signals — Prof. Mark R. Bell
Spring 2023 — MSEE 336

Course Information

Instructor: Prof. Mark R. Bell
Course Location: *On-Campus Section:* Tuesday and Thursday, 10:30–11:45am in room FRNY B124;
Online Sections: Lectures available by end of Tuesday and Thursday on Brightspace.
Office: MSEE 336
Phone: (765) 49-46412 **FAX:** (765) 49-43358
email: mrb@ecn.purdue.edu
Course Home Page: https://engineering.purdue.edu/~mrb/
Zoom Office Hours: Monday: 10:00–11:30am; Wednesday: 1:30–3:00pm .

Teaching Assistant: Jianqi Guo
email: guo498@purdue.edu
In-Person Office Hours(MSEE 292?): TBD
Zoom Office Hours: TBD

Course Materials: All course materials and information, with the exception of course videos, will be distributed through the course website (https://engineering.purdue.edu/~mrb/). *Brightspace* will not be used for distributing this material. The only material distributed through *Brightspace* will be course lectures, which are automatically recorded and posted to the course *Brightspace* page. Please become familiar with the course website at https://engineering.purdue.edu/~mrb/. Once there, go to the ECE600 drop-down menu.

Lecture Delivery: Live on-campus lectures will be given in FRNY B124 on Tuesdays and Thursdays from 10:30–11:45am. These lecture will be automatically recorded and posted on the course *Brightspace* page by the end of the day they are given.

Text: A. Papoulis and U. Pillai, *Probability, Random Variables and Stochastic Processes*, 4th Edition, McGraw-Hill, 2002.

Grading Policy: There will be 3 midterm exams worth 20% of the final grade each, and a final exam worth 40% of the final grade. Homework will be assigned approximately once a week, and solutions will be posted to the course web page after the suggested completion date, however homework will not be collected. There will be no make-up exams; if you miss a midterm exam your final exam score will be used in its place. If you are going to miss a midterm exam, you must tell me *before* the exam. Do not miss the final!

A Note on Homework: Although homework is not being collected, it is *essential* that you work through and understand the assigned homework problems. If you do not understand the homework problems, you may find the exams *very challenging*.

Midterm Exam Dates:

Exam 1:	Session 9	February 7, 2023
Exam 2:	Session 18	March 9, 2023
Exam 3:	Session 25	April 11, 2023

Additional References: The following books, while not required or necessary for the course, may be useful as additional references.

1. R. M. Gray and L. D. Davisson, *Introduction to Statistical Signal Processing,* Cambridge University Press, 2004. (A free pdf copy of the text can be downloaded from https://ee.stanford.edu/~gray/sp.html)
2. A.~Leon-Garcia, *Probability and Random Processes for Electrical Engineers*, 2nd Edition, Addison-Wesley 1989. (3rd Edition was published in 1994.)
3. Hwei Hsu, *Schaum's Outline of Probability, Random Variables, and Random Processes*, 4th Edition, (Schaum's Outlines) McGraw-Hill Education, 2019.

Academic Dishonesty: As graduate students, you are expected to behave with honesty and academic integrity in this course. In this respect, any action that would give any student an unfair grade advantage in this course will be considered *academic dishonesty*. Any case of academic dishonesty may result in a grade penalty on the assignment or in the course, as well as being reported to the Student Office of Rights and Responsibilities. Examples of academic dishonesty include, but are not limited to the following:

- Sharing information during an exam;
- Using forbidden material or a forbidden device during an exam;
- Viewing or working on an exam before or after the official time allowed;
- Requesting a regrade of work that has been altered;
- Submitting work that is not your own.

Copyright of Course Material: All ECE600 course material, including lecture notes, homework assignments, exams, and homework and exam solutions are protected by copyright law. Without Prof. Bell's permission, you are not allowed to distribute this material through any media, including online sources.

Emergency Procedures: Purdue is a relatively safe campus, however, we want to emphasize our emergency procedures for evacuation and shelter in place incidents in the event they are needed. To this end, we review the following procedures:

- To report an emergency, call 911. To obtain updates regarding an ongoing emergency, sign up for Purdue Alert text messages and view the current emergency status at **www.purdue.edu/ea**.
- There are approximately 300 Emergency Telephones distributed across campus and in parking garages. These connect directly to the Purdue University Police Department (PUPD). To use these, push the button on the phone and you will be connected to the PUPD immediately.
- If a fire alarm goes off during class, class will stop immediately. Evacuate the classroom immediately and head outdoors. Do not use the elevators.
- If we are notified during class of a Shelter in Place for a Tornado Warning, we will suspend class and shelter in the basement.
- If we are notified during class of a Shelter in Place for a hazardous material release, or a civil disturbance—including a shooting or other use of weapons, we will suspend class and shelter in the classroom, shutting and locking the doors and turning off the lights.
- Please review the Emergency Preparedness website for additional information: **http://www.purdue.edu/ehps/emergency_preparedness/index.html**

In the event of a major campus emergency, course requirements, deadlines and grading criteria are subject to changes that may be required by changes in the semester calendar or other circumstances. In such an event, information will be provided by email and the ECE642 course website.

ECE600: Random Variables and Signals

Credit 3, Spring 2022 Core Course, CNSIP Area

Prerequisites: Graduate Standing and a solid understanding of Calculus and Fourier transforms. (An undergraduate course in probability is helpful, but not essential.)

Description: Fundamentals of probability and random processes as applied to engineering. Serves as a prerequisite to more advanced courses in communications, signal processing, control, and other areas of ECE using probabilistic modeling (*e.g.,* optics, fields, networks, machine learning, statistical pattern recognition, *etc.)*

Text: *A.* Papoulis and U. Pillai, *Probability, Random Variables, and Stochastic Processes,* Fourth Edition, McGraw-Hill, 2002.

Course Outline:

- random experiments
- probability spaces
- conditional probability
- statistical independence of events
- compound and repeated random experiments
- random variables
- probability distributions and density functions of random variables
- expectation
- characteristic functions and moment generating functions
- multiple random variables defined on a random experiment
- statistical independence of random variables
- correlation
- sequences of random variables and stochastic convergence
- the weak law of large numbers
- the central limit theorem
- stochastic processes
- stationarity
- correlation and covariance functions
- power spectral density
- Gaussian random processes through linear systems
- point and renewal processes
- the Poisson process
- Erlang n-th arrival time of a homogeneous Poisson process

ECE600 Spring 2023 Course Schedule

Session No	Date	Event
1	1/10/23	Lecture
2	1/12/23	Lecture
3	1/17/23	Lecture
4	1/19/23	Lecture
5	1/24/23	Lecture
6	1/26/23	Lecture
7	1/31/23	Lecture
8	2/2/23	Lecture
9	2/7/23	Exam 1
10	2/9/23	Lecture
11	2/14/23	Lecture
12	2/16/23	Lecture
13	2/21/23	Lecture
14	2/23/23	Lecture
15	2/28/23	Lecture
16	3/2/23	Lecture
17	3/7/23	Lecture
18	3/9/23	Exam 2
Spring Break		
19	3/21/23	Lecture
20	3/23/23	Lecture
21	3/28/23	Lecture
22	3/30/23	Lecture
23	4/4/23	Lecture
24	4/6/23	Lecture
25	4/11/23	Exam 3
26	4/13/23	Lecture
27	4/18/23	Lecture
28	4/20/23	Lecture
29	4/25/23	Lecture
30	4/27/23	Lecture