West Virginia University
EE 513: Stochastic Systems Theory
(Probability and Stochastic Processes for Engineers)

General Information
Fall 2019

Instructor: Dr. Natalia A. Schmid (I would like you to call me Dr. Schmid)
Office: AERB 354
Telephone: 304-293-9136
E-mail: Natalia.Schmid@mail.wvu.edu
Office hours: TBA
Class Room: ESB-E G84
Meeting Time: M, W, F noon - 12:50 pm.
eCampus: Some information may be shared with you over eCampus e-mail.

1. Homework:
Homework will be assigned every 1.5 weeks. Hard copies of solutions will be distributed in class on the day homework is due. Three problems will be selected at random from each homework set. These problems will be graded carefully. The overall homework grade will be determined by subtracting the lowest score and then averaging over all remaining homework scores.

Homework is an important part of the course, so doing it thoughtfully and carefully is recommended.

2. Grade:
The final grade in this course will be determined as follows:

<table>
<thead>
<tr>
<th>The composition of the final grade</th>
<th>Grading Policy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homeworks, 30 %</td>
<td>A is guaranteed: 90-100 points</td>
</tr>
<tr>
<td>Midterm Exam, 30 %</td>
<td>B is guaranteed: 80-90 points</td>
</tr>
<tr>
<td>Final examination, 30 %</td>
<td>C is guaranteed: 65-80 points</td>
</tr>
<tr>
<td>Participation in class, 10%</td>
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</tbody>
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3. Prerequisites:
- STAT 215 or equivalent
- While there is no other specific prerequisite for this course besides graduate standing, some exposure and understanding of the following undergraduate subjects is assumed: linear signals and systems (EE 327); the “usual” undergraduate engineering mathematics (including Calculus I and II); and introduction to probability (EE 329).

4. Computer usage:
Some homework problems may require using a computer. No specific computer or computer language will be required.

5. Expected Learning Outcomes:
Upon successful completion of this course students will be able:

- To specify the probability space for a given random experiment;
- To define and describe a random variable;
To transform a single random variable and find probability density function of the transformed random variable;
To evaluate various functions of a single random variable;
To write expressions for joint and marginal probability density functions;
Given a transformation and a vector of random variables, to derive the probability density function for the transformed joint random variables;
To write expressions for conditional probabilities and conditional expectations;
To operate on jointly Gaussian random variables;
To state laws of large numbers and the central limit theorem;
To define and describe a random process;
To characterize random processes in linear systems;
To understand the concept of linear filtering;
To describe Wiener and Kalman filters (advanced topic);
To find Maximum Likelihood estimates of parameters (advanced topic);
To solve a simple binary decision making problem (advanced topic).

6. Textbook:
There are many textbooks about the subject of this course.

The one listed as required for this course is *Probability and Random Processes for Electrical Engineering* written by A. Leon-Garcia and published by Pearson Prentice Hall in 2008.

Some useful material and advanced topics are covered in the book *Probability, Random Variables, and Stochastic Processes* written by A. Papoulis. Another popular reference is *Probability and Random Processes for Electrical and Computer Engineers* by J. A. Gubner. Other books and references should be consulted as necessary for grasping the material.

7. Missed Test Policy:
You are expected to attend the midterm and the final exams at the scheduled times and dates. If you have an unavoidable conflict, please let me know as soon as possible, but no later than one week before the exam. If you miss an exam without first having your absence approved, then you will be given the opportunity to make it up only if you have received approval from the Associate Dean of Academic Affairs.

8. Regrading:
If you believe that I made a mistake or was unfair in my grading, you may request a regrade. However, the request must be made in writing and within one week that the assignment or exam was returned. The decision to change the grade is entirely at my discretion.

9. Attendance:
Attendance will not be taken. However, you will be responsible for all material covered in class, even if it is not in the textbook. It is your responsibility to make sure that you are present for all tests, that all assignments are turned in on time, and that you are aware of all announcements made in class.

- Please arrive to class on time.
- Please silence your cell phones.

10. Additional Information:
Two review and Q&A sessions may be scheduled throughout the semester. These sessions are to help students to prepare for their midterm and final tests. The date and time of each session will be announced in advance. Sessions may be held on Friday.
Inclusivity Statement:
The West Virginia University community is committed to creating and fostering a positive learning and working environment based on open communication, mutual respect, and inclusion.

If you are a person with a disability and anticipate needing any type of accommodation in order to participate in this class, please advise me and make appropriate arrangements with the Office of Disability Services (293-6700). For more information on West Virginia University's Diversity, Equity, and Inclusion initiatives, please see http://diversity.wvu.edu.

Academic Integrity Statement:
The integrity of the classes offered by any academic institution solidifies the foundation of its mission and cannot be sacrificed to expediency, ignorance, or blatant fraud. Therefore, I will enforce rigorous standards of academic integrity in all aspects and assignments of this course. For the detailed policy of West Virginia University regarding the definitions of acts considered to fall under academic dishonesty and possible ensuing sanctions, please see the Student Conduct Code at http://www.arc.wvu.edu/admissions/integrity.html. Should you have any questions about possibly improper research citations or references, or any other activity that may be interpreted as an attempt at academic dishonesty, please see me before the assignment is due to discuss the matter.

The major provisions of the Statler College policies for enforcing academic integrity follow:

- Grades assigned during the semester on exams, quizzes, reports, or homework assignments are considered final and are not subject to negotiation for any reason other than an indisputable mistake in grading.
- Use of cell phones, smart wearable devices, or possession of other external communication devices are strictly prohibited during exams, tests, or quizzes administered inside the classroom. Departments may specify acceptable calculators and additional restrictions.
- Common standards of academic integrity prohibit not only cheating or plagiarizing, but also the unethical conduct of trying to obtain grades that the student has not earned. Violations of academic integrity are described in the WVU Catalog: http://bit.ly/2hDAeUa.
- Students have the right to appeal final grades that do not involve charges of academic dishonesty. Students may appeal charges of academic dishonesty. The appeal process is outlined in the WVU Catalog: http://bit.ly/2uiMM9E.
- Incidents of student misconduct or academic dishonesty will be handled promptly and appropriately in accordance with the WVU Student Conduct Code and Discipline Procedure. The case will be referred to the Office of Student Conduct. Violations may lead to dismissal from the Statler College and expulsion from the University.
### Tentative Schedule

<table>
<thead>
<tr>
<th>Topic</th>
<th>Timeline</th>
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<tbody>
<tr>
<td>Course Policies; Schedule; Introduction: random experiments and related topics.</td>
<td>1 lecture</td>
</tr>
<tr>
<td>Introduction: random experiments; probability spaces. Theorem of total probability and Bayes’ Theorem.</td>
<td>2 lectures</td>
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<tr>
<td>Random variables: definition and characterization. Cumulative distribution functions &amp; generalized densities.</td>
<td>1 lectures</td>
</tr>
<tr>
<td>Mapping of a single random variable. Expectation, moments, characteristic functions, and other functions of random variables. Markov’s and Chebychev’s inequalities and Chernoff bound.</td>
<td>6 lectures</td>
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<tr>
<td>Joint random variables; Conditional probabilities; Transformations of joint random variables; Functions of joint random variables</td>
<td>7 lectures</td>
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<tr>
<td>Jointly Gaussian random variables</td>
<td>2 lectures</td>
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#### Midterm Exam

<table>
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<tr>
<th>Topic</th>
<th>Timeline</th>
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<tr>
<td>Law of large numbers</td>
<td>1.5 lecture</td>
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<tr>
<td>Central limit theorem</td>
<td>1.5 lecture</td>
</tr>
<tr>
<td>Random processes: definition and characterization</td>
<td>3 lectures</td>
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<tr>
<td>Covariance and power spectra</td>
<td>2 lectures</td>
</tr>
<tr>
<td>Random processes in linear systems</td>
<td>3 lectures</td>
</tr>
<tr>
<td>Gaussian (and Poisson) Processes</td>
<td>2 lecture</td>
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<tr>
<td>Wiener and Kalman Filtering</td>
<td>4 lectures</td>
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<tr>
<td>Intro to Hypothesis Testing</td>
<td>3.5 lectures</td>
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<tr>
<td>Basics of Estimation Theory</td>
<td>3.5 lectures</td>
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#### Final Examination

- Midterm Exam: **TBA** (will be announced two weeks prior to the exam)
- Final: **TBA**

Total: 44 lectures