



Rensselaer

Introduction to Stochastic Signals and Systems Fall 2018

Course Information

Introduction to Stochastic Signals and Systems	ECSE 6510	Section 01
RPI Fall 2018	3 credits	
Lecture	TF 10:00-11:20AM	Location: JEC4107

Course Website: RPI LMS

Prerequisites or Other Requirements

ESCE-2410: Signals and Systems (or equivalent), and,
ESCE-2500: Probability (or equivalent).

Instructor

Prof. Alhussein Abouzeid
Office Location: JEC 6038
Office Hours: Tuesdays 1:30-2:30 PM, or by appointment
Email: abouzeid@ecse.rpi.edu
This course has no TA.

Course Description

This course introduces probability from an axiomatic and measure-theoretic perspective with applications in communication, sensing and imaging, pattern recognition and other signal processing systems. The course covers concepts of stochastic processes, wide sense stationarity, spectral decomposition, Brownian motion, Poisson processes, Markov processes; and other advanced topics.

Student Learning Outcomes

1. Develop an in-depth knowledge of the theory of probability and stochastic processes.
2. Be able to apply probability and stochastic process theory to model and analyze typical electrical and computer engineering systems.
3. Be able to evaluate the performance of engineering systems with uncertainty.

Course Content

1. Review of Probability Axioms and Random Variable
2. Convergence and limit theorems
3. Stochastic Processes
4. Poisson, Wiener and Markov Processes
5. Stationary Processes
6. Autocorrelation
7. Spectral Density
8. Effects of Filtering
9. Cyclo-stationary Processes*
10. Stochastic Derivatives and Integrals

11. Karhunen-Loeve Expansion*
12. Markov Chains, Random Walks, and Other Applications
13. Applications in Computer Networking and Statistical Signal Processing

Items with "" will be covered if time permits.*

Course Text(s)

1. A. Papoulis and S.U. Pillai, Probability, Random Variables, and Stochastic Processes, Fourth Edition, McGraw Hill, 2002.
(Very comprehensive, but new students might get lost in it.)

Optional Additional References

1. Bruce Hajek, *Random Processes For Engineers*, Cambridge University Press, 2015.
Pre-production copy of this book is available for free for educational use at:
<http://hajek.ece.illinois.edu/Papers/randomprocJuly14.pdf>
(Very comprehensive and in-depth. May be too dense/sophisticated for students new to stochastic processes.)
2. A. Leon-Garcia, *Probability and Random Processes for Electrical Engineering*, 2nd ed., Prentice Hall, 1993.
(Easy to follow, but not comprehensive enough.)
3. S. Ross, *Stochastic Processes*, 2nd ed., Wiley, 1995.
(Easy to follow, particularly useful for discrete & CS applications. Not much coverage for continuous time processes.)
4. R. Gallager, *Stochastic Processes: Theory for Applications*, Cambridge University Press, 2014.
(Easy to follow, particularly useful for continuous & EE communications applications. Detailed description of Gaussian processes. Not enough coverage for continuous time.)
5. R.D. Yates and D.J. Goodman, *Probability and Stochastic Processes: A Friendly Introduction for Electrical and Computer Engineers*, Second Edition, Wiley, 2004.
(Easy to follow, good for probability review, but does not cover enough of advanced topics.)
6. *Probability, Random Processes, and Estimation Theory for Engineers*, 3rd Edition, H. Stark and J. W. Woods, 2002.
(Rigorous, not quite easily accessible for starting students, focuses on continuous time.)

Course Assessment Measures

Assessment	Due Date	Learning Outcome #s
Homework assignments, term exams and in-class problems	To be posted	1-3

3 Term Exams		25% each; total 75%
Exam 1	9/28	
Exam 2	11/6	
Exam 3	12/11	
Homeworks (total 7, approximately every two weeks)		25%
In-class Problems		+5% to total

Note: Only a random subset of the homework problems in each HW assignment will be graded, and the total score will be assigned based on the graded problems.

Other Course Policies

Homework Problems:

- Homework will be assigned approximately bi-weekly, posted on LMS. It is due at the beginning of class on their due date.
- Late homework will not be accepted.
- All homework assignments are to be completed on your own. You are allowed to consult with other students in the current class regarding the conceptualization of the problem and possible methods of solution, but you may not share details, whether in the form of scrap work, or final write-ups. You may not copy solutions from anyone or any source.
- You may not knowingly provide your work to be copied.

Attendance Policy: While class attendance is not mandatory, it is important to performing well in this course, and necessary to receive in-class credit. Regular class attendance is important for maximum learning effectiveness and it significantly improves performance on graded course deliverables.

Term Exams Grading Assessment: Shortly after each Term Exam, the class averages and standard deviations will be announced in class. This information will enable students to approximate their class standing and expected course grade.

Submission Policy and Absences:

A job interview is not an approved absence unless approved beforehand, with appropriate note from the Dean of Students. An approved absence is one that has been approved following Rensselaer's rules and procedures, and should be documented, typically via a letter from the dean's office, and emailed beforehand to the instructor. A missed exam due to an unexpected emergency should be communicated in writing as soon as possible.

- All *in-class activities* are due in class after the allotted time expires. No late activities are accepted. In case of a valid excuse, a missed activity grade will not be taken into account in computing the average grade of activities, as long as there is at least one submitted activity. Otherwise a grade of zero is given for a late/missing activity.
- All *homework* assignments are due *within 5 minutes of the start class* on the due date. Late submissions are not accepted. In case of a valid excuse, a missed homework grade will not be taken into account in computing the average grade of homeworks, as long as there is at least one submitted homework. Otherwise a grade of zero is given for a late/missing homework.
- All *term exams* are due at the due date/time. In case of a valid excuse, a make-up exam will be held at a time that is to be agreed with the instructor. The make-up exam has to be completed within one week of the missed exam date.

Exam/Homework Policy for Snow Days or Class Cancellations for Other Reasons:

If there is a snow day or class cancellation for other reasons on the day of an exam, the exam/due date is postponed to the next class. Students will receive an email notification to their RPI accounts.

Academic Integrity

- Student-teacher relationships are built on trust. For example, students must trust that teachers have made appropriate decisions about the structure and content of the courses they teach, and teachers must trust that the assignments that students turn in are their own. Acts that violate this trust undermine the educational process. The Rensselaer Handbook of Student Rights and Responsibilities defines various forms of Academic Dishonesty and you should make yourself familiar with these.
- In this class, all assignments (exam, homework or in-class activity) that are turned in for a grade must represent the student's own work completed independently. In cases where help was received, or teamwork was allowed, a note on the assignment should indicate the nature of the collaboration and the names/identities of the collaborators.
- **Mobile Devices:** All mobile devices (cell/smart phones, computers, pagers, etc.) must be stored securely away during lecture and are not be used unless specifically directed otherwise by the instructor. Use of (or ANY interaction with) a mobile device during an exam without explicit permission of the instructor will be interpreted as the illicit transfer of exam data, will be considered an act of cheating and will be treated as such.”
- Any incident of violation of this policy on an exam/assignment will result in at least a penalty of 0 for the first incidence (depending on the gravity), and a class grade of F for a repetition or a straight F grade even for first violation depending on the gravity. A grade of F due to violation(s) will also be reported to the Dean of Students.
- If you have any question concerning this policy before submitting an assignment/exam, please ask for clarification in writing.