For Revised and Updated Syllabus Please See: https://cnl.gmu.edu

Syllabus

ECE 528: Introduction to Random Processes in ECE

Course Number: ECE 528
Recommended Prerequisite: ECE 220 and STAT 346 (all with grade of C or better), or permission of instructor.

Instructor: Bijan Jabbari, Professor
Semester: Fall 2024
Lecture Time: Monday 4:30-7:10 pm, Music/Theater Building 1002

Office: Eng. Bldg. Room 3232
Office phone: 703-993-1618
Email: bjabbari@gmu.edu
Web: http://cnl.gmu.edu
Office hours: Mondays 1:30-2:30 pm
Other times by appointment only

Teaching Assistant: Maryam Farazadeh (email: mfarajza@gmu.edu)
Recitation Time: Wednesday 7:20-8:35 pm in Music Hall Room 1002
Office hours: TBD
Other times by appointment only

Administrative Assistant: N/A

Course Description
Probability and random processes are fundamental to communications, control, signal processing, and computer networks. Provides basic theory and important applications. Topics include probability concepts and axioms; stationarity and ergodicity; random variables and their functions; vectors; expectation and variance; conditional expectation; moment-generating and characteristic functions; random processes such as white noise and Gaussian; autocorrelation and power spectral density; linear filtering of random processes, and basic ideas of estimation and detection.

Course Outline
- Probability Models in ECE
- Review of probability: set theory, basic concepts, probability spaces, conditional probability, Bayes' Rule, independence, Borel Fields, Generation of random numbers
- Discrete Random Variables: Notion of Random Variables, Probability Mass Functions (PMF), Expected Value and Moments, Important Discrete Random Variables, Generation of Discrete Random Variables
- General Random Variables (Single Variable): Cumulative Distribution Functions (CDF), Probability Density Functions (PDF), functions of random variables, expectations and characteristic function, Markov and Chebyshev inequalities
- Pairs of Random Variables: joint and marginal distributions, conditional distributions and independence, functions of two random variables, Expectations and correlations, pairs of jointly Gaussian Random Variables, generating jointly Gaussian Random Variables
- Random vectors: Functions of several random variables expected value of vector random variables, jointly Gaussian Random vectors, convergence of random sequences
- Sums of random variables and long-term averages: the sample mean and the Laws of Large Numbers, the Central Limit Theorem

- Stochastic Processes: Basic concepts, Covariance, correlation, and stationarity, Gaussian processes and Brownian motion, Poisson and related processes, Power spectral density, Stochastic processes and linear systems, Matched filter
- Markov Processes and Markov Chains

Textbook and References:

- **Required Textbook:** A. Leon-Garcia, Probability, Statistics, and Random Processes for Electrical Engineering, 3rd Edition, Pearson Prentice Hall, 2008.

- **Recommended Introductory Textbook:** D. P. Bertsekas and J. N. Tsitsiklis, Introduction to Probability, Athena Scientific, Belmont, MA, 2nd Edition, 2008. See http://www.athenasc.com/probbook.html

Grading:
There will be weekly homework assignments along with several projects. Homework will be assigned on Mondays and will be due by 4:00 pm of the following Monday (except holidays). Projects should be typed and follow a specific given format. You should upload your solutions to Blackboard. Projects will typically be due two weeks after being assigned. Late submissions will not be accepted. Projects submission should conform to the format provided and contain sufficient details to facilitate understanding of the code.

There will be one Mid-Term exam, and a final exam (comprehensive). They will count towards the grade as follows:

- Homework and MATLAB Projects 15%
- Mid-term 40% (Tuesday Oct 15)
- Final Exam 45% (up to 2 hours and 30 minutes) – see the schedule of Final Exams (Dec 16)

Mason expects students to pursue their academic work with honesty and integrity. Students should feel free to work in groups to discuss lecture material and homework assignments; however, under no circumstances should a student represent another's work as his/her own. Copying solutions for assigned homework problems, from any source, constitutes a violation of the university honor code. Any forms of cheating may cause penalties, from getting a failing grade in this course to academic actions in accordance with university policy.

Course and University Policies

Academic Integrity and Honor Code:
Honesty and integrity are at the core of Mason academic programs, research and community. George Mason University's honor code states the following:

Honor Code Statement To promote a stronger sense of mutual responsibility, respect, trust, and fairness among all members of the George Mason University Community and with the desire for greater academic and personal achievement, we, the student members of the university community, have set forth this Honor Code: Student Members of the George Mason University community pledge not to cheat, plagiarize, steal, or lie in matters related to academic work.

Avoid Reposting Course Material: It is not allowed to reposting course material. The course materials (lecture notes, homework, projects, exams, solutions, and anything else posted on the course website) are copyrighted. You may not upload them to any other website or share them with any on-line or off-line test bank.

Communications and Technology: Students should use their Mason email account to receive important

university information, including messages related to this class (see https://mail.gmu.edu/). Also, please write ECE528 on the subject line when you send me an email. Blackboard is used to complement the course webpages hosted at Mason https://CNL.gmu.edu. If you need to familiarize yourself with Blackboard, please see https://mymasonportal.gmu.edu. All course materials posted to course webpages, including Blackboard, are private to this class; by federal law, any materials that identify specific students (via their name, voice, or image) must not be shared with anyone not enrolled in this class. Similarly, any video recordings of class meetings that include audio, video, or textual information from other students are private and must not be shared outside the class. Live video conference meetings (e.g. Collaborate or Zoom) that include audio, textual, or visual information from other students must be viewed privately to the extent possible, and should not be shared with others in your household or recorded and shared outside the class.

University Policies: The University Catalog, https://catalog.gmu.edu/, is the central resource for university policies affecting student, faculty, and staff conduct in university academic affairs. Other policies are available at http://universitypolicy.gmu.edu/. All members of the university community are responsible for knowing and following established policies. Academic integrity is of great importance to the Mason community. Mason provides accommodations through the Office of Disability Services.

Office of Disability Services: Mason provides accommodations through the Office of Disability Services (ODS) http://ods.gmu.edu. If you are a student with a disability and you need academic accommodations, please see me and contact ODS at 993-2474.

Student Support Resources on Campus: are available through Stearn Learning Center: See https://stearnscenter.gmu.edu/knowledge-center/knowing-mason-students/student-support-resources-on-campus/

Inclusion and Non-Discrimination Policy: See https://ssac.gmu.edu/

Other Useful Campus Resources:
Writing center: See http://writingcenter.gmu.edu or 703-993-1200
University libraries: See https://library.gmu.edu

Counseling and Psychological Services: For CAPS see https://caps.gmu.edu/ or 703-993-2380.

Safe return to campus: https://www.gmu.edu/safe-return-campus and the COVID Safety Plan (PDF).