University of Maryland Eastern Shore
Department of Engineering and Aviation Sciences
Course Syllabus

Course Title: ENEM 603, Random Signals Analysis
Section 0101, 3 credit

Course Description:
This is an introductory course in digital signal processing, covering the basic principles governing the design and use of digital systems as signal processing devices. Topics include: properties of discrete-time signals and systems, sampling theory, transform analysis, system structures, effects of finite precision arithmetic, digital filtering in time and frequency domain, IIR and FIR filter design techniques, the Discrete Fourier Transform, and Fast Fourier Transforms. The objective of this course is to provide a basic introduction to the theory of digital signal processing (DSP). Major parts of the course will concentrate on signal analysis using Fourier transforms, linear system analysis, Filter design and a few more advanced topics.

Place and Time: EACM Building, Room 1064
Monday Wednesday Friday 4:00 pm - 4:50 pm

Instructor: Dr. Liang Zhang
***e-mail*:** lzhang1@umes.edu
Phone: 410-651-6478
Office: Room 3007, EASC building,

Office Hours: Monday 2 pm – 4 pm, Wednesday 2 pm – 4 pm, and other times by appointment only.

Prerequisite/Co-requisite:

Textbook:

- **Probability, Statistics, and Random Processes for Electrical Engineering , 3rd Edition, by Alberto LeonGarcia, Pearson Prentice Hall, 2008.**
- **D. P. Bertsekas and J. N. Tsitsiklis, Introduction to Probability. Athena Scientific, Belmont, MA, 2nd Edition, 2008.**
- Additional material will be provided if necessary.

Course Objectives:

1. To introduce the basic theoretical concepts and techniques for solving problems that arise in practice.
2. To provide the fundamental system aspects of probability theory and stochastic processes.
3. To introduce the use of probability theory to solve real problems in the world.
4. To provide a clear understanding of random signals with different distributions, e.g., Uniform distribution, Poisson distribution, Exponential distribution, Bernoulli distribution, Binomial distribution, Geometric distribution, Normal distribution, and Rayleigh distribution.
5. Be able to design, generate, and analyze different random signals in the digital system.
6. Get familiar with the required programming language (Python/Matlab) skills, and professional tools.

Class Attendance and Participation:

- All students are expected to attend all classes. Class attendance is regarded as an obligation as well as a privilege and all students are expected to attend regularly and punctually all classes in which they are enrolled. Excessive unexcused absences for any reason will result in either a low grade or course failure. All students will be considered excessively absent from class if they miss class more than four hours during the semester.
- Participation means class attendance and being active in class discussions. Asking questions is expected but it is not considered participation. Answering questions correctly, staying ahead, and being on top of the classroom discussions are examples of participation.
- Eating, drinking, or chewing gum is **not** permitted in the classroom.
- Talking to each other is **not** permitted during the lectures.
- Taking naps is **not** permitted in the classroom.
- Your cell phone has to be turned off and kept in your handbag or pocket while you are in the classroom.
- If you cannot attend class, a courtesy call or an email to the professor is required and appropriate.

Course Requirements:

All students' work submitted for grading is pledged to be done without any unauthorized help. Students may study together but are required to do their work for graded material. **All work is individually pledged.**

Students whose names do not appear on the official class roster will not be allowed to attend the class after the add period ends.

Homework:

- Homework assignments will be selected from textbooks, references, and other resources.
- Assignments will be made as needed and will be due based on the deadlines to be announced. Other due dates would be determined in some special cases.
- Late assignments will not be accepted.
- Suggested solutions will be provided after the due date.

Exams Schedule:
Exams will emphasize basic concepts developed in the course. Details will be announced in advance.
No make-up exams will be given for the scheduled exams and the grade for a missed exam will be zero unless the student has a legitimate excuse documented properly (e.g., a letter from a court clerk that he/she must appear in a court, a letter from a physician that he/she is sick). The student must make an appropriate arrangement with the instructor for an excused missed exam.

- The **Mid-term exam** will be held in the regular classroom and the schedule will be announced in advance.
- The **Final exam** will be held in the regular classroom and the schedule will be announced in advance.

Grading Policy:
- A grade of "I" will not be given to students who have a failing grade going into the finals.
- Grades will be based on exams, assignments, quizzes, and class participation (oral or written responses).

Tentative Point Allocation:

Participation and Quizzes	10%
Homework	15%
Project	15%
Mid-Term Exam	25%
Final Exam	35%
_____	_____
Total	100%

Tentative Grading Scale:
Grades will be based on the following numerical guidelines*.

Average Range	Grade
90-100	A
80-89	B
70-79	C
60-69	D
Below 60	F

*These ranges may vary depending on curves, should any apply, or class grade distribution.

Course Content:

Week	Topic	
1	Course overview, basic concepts in probability, Probability Models in ECE	
2	Review of probability: set theory, probability spaces	
3	More on conditional probability, Bayes' Rule, independence, more on the generation of random numbers	
4	Discrete Random Variables: Notion of a Random Variable, Probability Mass Functions (PMF), Expected Value, Moments, Important Discrete Random Variables, Generation of Discrete Random Variables	
5	General Random Variables (Single Variable): Cumulative Distribution Functions (CDF), Probability Density Functions (PDF), functions of random variables, expectations and characteristic function, Markov and Chebychev inequalities	
6	General Random Variables (Single Variable): Cumulative Distribution Functions (CDF), Probability Density Functions (PDF), functions of random variables, expectations and characteristic function, Markov and Chebychev inequalities	
7	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 (chap 5)	
8	MidTerm	
9	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 (chap 5)	
10	Random vectors: Functions of several random variables expected value of vector random variables, jointly Gaussian Random vectors, convergence of random sequences (chap 6)	
11	Random vectors: Functions of several random variables expected value of vector random variables, jointly Gaussian Random vectors, convergence of random sequences (chap 6)	
12	Sums of random variables and long-term averages: the sample mean and the Laws of Large Numbers, the Central Limit Theorem (chap 7)	
13	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 (chap 9)	
14	Stochastic Processes	
15	Markov Processes and Markov Chains (chap 11) – Last Class	
16	Final Exam	

COURSE ASSESSMENT:

The Accreditation Board of Engineering and Technology (ABET) requires that engineering programs demonstrate their graduates have the following outcomes or competencies:

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
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

3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. 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
6. an ability to develop and conduct appropriate experimentation, analyze, and interpret data, and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

The course is assessed using formative and summative assessments in the form of homework, quizzes, the mid-term exam, and the final exam.

Tests, homework, quizzes, and projects will assess ABET outcomes 1, 2, 6, and 7.

Course Objectives	Course Assessment Methods	Extent of Coverage of Program Outcomes	Applicable ABET Program Criteria Outcomes
1,2,3,4,5	Homework, quizzes, projects, exams	Significant	1
2,3	Homework, quizzes, projects, exams	Significant	2
4,5	Homework, quizzes, projects, exams	Significant	6
3,5	Homework, quizzes, projects, exams	Significant	7

Instructions for Student Athletes:
Any student-athlete enrolled in class must make an appointment within the first week of the semester to meet with the instructor so that game schedules and travel schedules can be discussed and the instructor can clarify the athlete's procedures and policy on make-up work. Student-athletes are reminded that absences (whether excused or unexcused) do not relieve them of their responsibility to complete course assignments. Instructors must know in advance that absences related to athletic events will occur so that early planning can take place. (See attached policy on class attendance)."

Dress Code:
Students are expected to exercise good judgment concerning appropriate dress for the classroom. Dressing appropriately in an environment that is conducive to learning requires that clothing not be distracting and is sufficient in quality and quantity to cover and protect the body (particularly in laboratories). Individual freedom of dress is upheld at UMES, but students should be respectful of the sensitivities of others and recognize that dressing professionally is a part of the training the university desires to provide. Attire that is more appropriate for the bedroom or nightclubs should not be worn in the classrooms, as such may be distracting or offensive to others.

Student Professional Code of Conduct:
This Student Code of Conduct was created to support a productive and stimulating learning environment in all School of Business and Technology classes. The code is designed to help ensure a positive atmosphere for the vast majority of students who currently exhibit the professional standards detailed below.

- Students should exhibit professional classroom values and behavior by:
  - Engaging in appropriate communication and interaction.
  - Demonstrating trust, respect, and civility.
  - Approaching course content is important and necessary for the success in business.
  - engaging in responsible classroom activities such as:
    - turning off cell phone ringers
    - avoiding unnecessary talking
    - not reading outside material or doing other work during class

- Students should contribute to a positive learning environment by:
  - Arriving, attending, and departing class in a professional manner.
  - Taking responsibility for team and individual assignments.
  - Developing cooperative relationships with other students and faculty.

- Students should support a professional environment within the School of Business and Technology by:
  - Avoiding inappropriate language in and near classrooms and offices.
  - Refraining from unrealistic expectations in dealing with administration, faculty, and staff.

- Students must uphold the academic integrity standards. Academic integrity is conceptualized as doing and taking credit for one's work. Violations of the university's academic integrity standards include, but are not limited to:
  - Cheating in the classroom. Cheating includes using unauthorized sources of information and providing or receiving unauthorized assistance on any form of academic work.
  - Examples of cheating include giving answers to others in a testing situation without permission of the instructor; taking or receiving answers from others in a test situation without permission of the instructor; having possession of test materials without permission; taking, giving, or receiving test materials before tests without permission; having someone else take a test or perform an assignment for you; submitting as your own work, work done by someone else; permitting someone else to submit your work under that person's name; falsifying research data or other research material; copying with or without permission any work, e.g., essays, short stories, poems, etc., from a computer, hard drive or discs and presenting them as your own.
  - Plagiarism. Plagiarism includes the copying of language, structure, ideas, or thoughts of another, and representing them as one's own without proper acknowledgment.
  - Examples of plagiarism include taking ideas from a source without clearly giving proper reference in a way that identifies the original source of the ideas and distinguishes them from your own; indirectly quoting or paraphrasing material taken from a source without clearly giving proper reference in a way that identifies the original source and distinguishes the paraphrased material from your own compositions; directly quoting or exactly copying material from a source without giving proper reference or otherwise presenting the copied material as your own creation.
  - Unauthorized Possession or Disposition of Academic Materials. Unauthorized possession or disposition of academic materials includes the unauthorized selling or purchasing of examinations or other academic work; stealing another student's work; unauthorized entry to or use of material in a computer file; theft or mutilation of library materials; and using information from or possessing exams that an instructor did not authorize for release to students.
  - Falsification. Falsification encompasses any untruth, either verbal or written, in one's academic work.
  - Facilitation of Cases of Academic Dishonesty. Facilitation of any act of academic dishonesty including cheating, plagiarism, and/or falsification of documents also constitutes a violation of the university's academic integrity.

Academic Honesty and Integrity

Academic honesty and integrity lie at the heart of any educational enterprise. Students are expected to do their work and neither give nor receive assistance during quizzes, examinations, or other class exercises. Because the university takes academic honesty seriously, penalties for violations may be severe, including failing the course and possibly being dismissed from the university. Students accused of academic dishonesty will be given due process before disciplinary action is taken. **Please request the most current policy and procedure followed when academic dishonesty accusations are lodged by faculty against students from the faculty member, the academic advisor, or the department chair.**

Precautionary Disclaimer

The instructor reserves the right to amend the course syllabus during the term. If changes must be made, students will be notified. Notice given during class is considered proper notice. Office hours are subject to change depending on the instructor's schedule.