University of Massachusetts Amherst
Department of Electrical and Computer Engineering
ECE 313 - Signals and Systems
Fall 2017 Syllabus

DESCRIPTION

"IT WOULD BE DIFFICULT TO OVERSTATE THE IMPORTANCE OF THE FOURIER TRANSFORM. IT IS USED IN ALMOST EVERY AREA OF SCIENCE AND ENGINEERING, AND IT EVEN POPS UP IN PURE MATHEMATICS WHEN YOU LEAST EXPECT IT, E.G. DERIVING THE FIRST BILLION DIGITS OF PI. THE COMPUTER YOU ARE USING TO BROWSE THIS WEBSITE PROBABLY HAS 4 DIFFERENT IMPLEMENTATIONS OF THE FOURIER TRANSFORM, IN VARIOUS APPLICATIONS, PLUS A COUPLE MORE IN HARDWARE AND/OR MICROCODE."

Karl Dahlke, mathreference.com

This course focuses on the study of signals and linear systems. It constitutes the basic theory behind a further study of communication theory and systems, control theory and systems, signal processing, microwave and radar systems, networking and almost all disciplines of electrical and computer systems engineering.

INSTRUCTION TEAM

Lectures: Prof. Patrick Kelly, Marcus Hall 215B, kelly@ecs.umass.edu, Phone: 545-3637
Office Hours: Monday, 3-5 PM (or by e-mail appointment)
Roles: Lectures, Exams

Discussions: Prof. Marco Duarte, Marcus Hall 215I, mduarte@ecs.umass.edu, Phone: 545-8583
Office Hours: Tuesday, 10-11 AM and 3-4 PM (or by e-mail appointment)
Roles: Discussions, Homeworks, Discussion Quizzes

Teaching Assistants: (Office Hours in Marcus 106)
Natesh Ganesh, nganesh@umass.edu, Office Hours: Tuesday, 4-6 PM
Pavithra Balram Jaganathan, pjaganathan@umass.edu, Office Hours: Monday, 5-6:30 PM

Supplemental Instruction (SI): (SI Sessions in ELab 306)
Battsooj Bayarsaikhan (SI Leader), Monday, 7-8:15 PM and Wednesday, 5:30-6:45 PM

You are always welcome to come to office hours with any questions about the course. Since this is a large class, coming to office hours will also make it easier for us to get to know you.

COURSE FORMAT

Lecture: 10:10 AM–11:00 AM on Monday, Wednesday, and Friday @ Goessmann 120.
Discussion: One 50-minute session on Friday. Sections: 12:20 PM, 1:25 PM, and 2:30 PM @ ELab 305.

PREREQUISITES

Students must have obtained a grade of C or better in ECE 212 (Circuit Analysis II) and have taken either MATH 235 (Linear Algebra) or MATH 331 (Differential Equations).

TEXTBOOK

No textbook is required. Most of the content is covered in a collection (online course notes) in OpenStax CNX (cnx.org). You can browse through course modules (lecture notes) on the website or download them as PDF files to print. However, online notes will be updated through the semester to correct mistakes and typos, so let the instruction team know if you find any. The collection URL is http://cnx.org/content/col11557/. Several options exist for students who want to follow a textbook during the course:

- M. L. Roberts, "Fundamentals of Signals & Systems," McGraw Hill, 2007.
- B. P. Lathi, "Linear Systems and Signals," Second Edition, Oxford, 2004.
- A. V. Oppenheim, A. S. Willsky, S. H. Nawab, "Signals and Systems," Prentice Hall, 1997. (Available at the Integrated Science Library)
- H. Hsu, "Signals and Systems," Schaum's Outline Series, McGraw Hill, 2014. (This book provides a large number of problems and worked-out examples.)

ECHO 360 LECTURE CAPTURE

The lectures for this course will be recorded using the Echo 360 Lecture Capture system. The lectures will be available for viewing only through a link on the class Moodle page. The focus of the recordings will be the material presented in lecture, and efforts will be made not to capture images of students. However, it is possible that there will be audio capture of questions asked in class. Please contact the instructors if you have any concerns or questions about the lecture recordings.

GRADING

- Midterm Exam 1: 25% (Wednesday Oct. 11, 7-9 PM, Thompson 102)
- Midterm Exam 2: 25% (Wednesday Nov. 15, 7-9 PM, Morrill 1 N375)
- Final Exam: 30% (Tuesday, De. 19, 8-10 AM, ELab II Room 119)
- Homework assignments: 15%
- Discussion Quizzes: 5%

HOMEWORK ASSIGNMENTS

There will be approximately nine homework assignments (one every week, except for exam weeks) that will be posted on the Moodle course website at https://moodle.umass.edu. Each assignment will be posted on a Wednesday and due the following Wednesday. Assignments must be turned in at the beginning of the class period on the due date. Late submissions will **not** be accepted. Discussion of the problem sets with other students is encouraged, but each student must turn in a unique personal write-up or code implementation. *Homework assignments are preparation for exams*, so do not rely too heavily on other students for help. Homework solutions will be posted online in Moodle after the due deadline.

Note: Some homework problems will require the use of MATLAB. MATLAB is available on the machines in the ECS computer labs and through the ECS Virtual Lab (http://engineering.umass.edu/about-us/engineering-computer-services/virtual-lab). You can also get a trial version at a 100% discount for your own computer - for details see the web page: www.umass.edu/it/support/software/mathworks-licenses-matlab-simulink-and-symbolic-math-toolbox

EXAMS

All exams will be closed-book and closed-notes; calculators will **not** be allowed. Exam packets will include some formula sheets (for example, Fourier transform pairs) and will be disclosed in advance by the instructors. Additionally, a **single-sided handwritten** formula sheet will be allowed for exams 1 and 2, which are non-cumulative. The final exam will be cumulative and a **double-sided handwritten** formula sheet will be allowed.

DISCUSSION QUIZZES

A quiz will be given during the discussion session before each exam. The quizzes are meant to provide additional (and realistic) preparation for exams. Solutions will be posted on Moodle.

PIAZZA

This term we will be using Piazza for class discussion. The system is highly catered to getting you help quickly and efficiently from classmates and the instruction team. Rather than emailing questions to an instructor or TA, we encourage you to post your questions on Piazza. If you have any problems or feedback for the developers, email team@piazza.com. Find our class page at: www.piazza.com/umass/fall2017/ece313

HONORS COLLOQUIUM

Students who intend to complete the Departmental Honors Track should enroll in the 1-credit ECE 313 Honors Colloquium (ECE 313H). The Honors Colloquium will involve team-based projects and will begin meeting in early October. More details will be sent soon to students who have registered for the colloquium.

ACADEMIC HONESTY POLICY

It is expected that all students will abide by the Academic Honesty Policy, available at the Academic Honesty Office (Ombud's Office), or online at http://www.umass.edu/dean_students/codeofconduct/acadhonesty/. Acts of academic dishonesty (such as taking or giving answers in an exam, use of extra crib sheets, submitting another person's work as your own, etc.) will result in a grade of F in the course, and possibly additional sanctions including being placed on probation or suspension for a period of time or being dismissed from the University. All students have the right of appeal through the Academic Honesty Board.

ACCOMMODATION POLICY

The University of Massachusetts-Amherst is committed to providing an equal educational opportunity for all students. If you have a documented physical, psychological or learning disability on file with Disability Services (DS), Learning Disability Support Services (LDSS) or Psychological Disabilities Services (PDS), you may be eligible for reasonable academic accommodations to help you succeed in this course. If you have a documented disability that requires an accommodation, please notify the instructors within the first two weeks of the semester so that we may make appropriate arrangements.

INCLUSIVITY AND DIVERSITY

The diversity of the participants in this course is a valuable source of ideas, problem solving strategies, and engineering creativity. If you feel that your contribution is not being valued for any reason, please speak with one of the instructors privately. If you wish to communicate anonymously, you may do so in writing or speak with Dr. Paula Rees, Director of Engineering Diversity Programs (rees@umass.edu, 413.545.6324, Marston 128). We are all members of an academic community where it is our shared responsibility to cultivate a climate where all students/individuals are valued and where both they and their ideas are treated with respect.

TENTATIVE LECTURE SCHEDULE

Week 1: Why Learn All This Math? Complex numbers. Graphical operations.

Part 1: Continuous-Time Signals and Systems
Week 2: Continuous-Time Signals. Basic Operations. Classifications and Properties.
Week 3: Continuous-Time Systems. Classification and Properties. System Analysis: Convolution.
Week 4: The Continuous-Time Fourier Transform. Advantages for Analysis (No convolution).
Week 5: Properties of the Continuous-Time Fourier Transform.
Week 6: More Properties of the Continuous-Time Fourier Transform. (Yes, it's that useful)

Part 2: Discrete-Time Signals and Systems
Week 7: Discrete-Time Signals. Basic Operations. Classifications and Properties.
Week 8: Discrete-Time Systems. Classification and Properties. System Analysis: (Easier) Convolution.
Week 9: The Discrete-Time Fourier Transform. Properties and Advantages (Again, no convolution).
Week 10: Properties of the Discrete-Time Fourier Transform: Déjà-Vu All Over Again.

Part 3: From Continuous to Discrete: Sampling Theory
Week 11: Connecting Continuous and Discrete-Time Signals and Systems: Sampling. Aliasing.
Week 12: Discrete-Time Processing of Continuous-Time Signals: All About Bandwidth.
Week 13: Applications in Sensing and Communication. Connections with Other Topics.