University of Massachusetts
Department of Electrical and Computer Engineering

ECE 313 - Signals and Systems
Fall, 2012

http://www.ecs.umass.edu/∼goeckel/ece313.html

"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 π. 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 microde."

From "www.mathreference.com/la-xf-four,intro.html".

"Knowledge of the Fourier transform is one of the three things that **defines** *you as an Electrical or Computer Systems Engineer. And I can't think of the other two things."*

Prof. Goeckel, numerous occasions.

Objective: 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.

Course Format:

- Lecture: Three 50-minute lectures (MWF 10:10 in AgEng 119).
- Recitation: One 50-minute recitation (F 12:20 in ELAB 305, F 1:25 in ELAB 305, or F 2:30 in ELAB 325).

Instructors:

Prof. Dennis Goeckel
Contact: Office: Marcus Hall 215L, Phone: 545-3514, e-mail: goeckel@ecs.umass.edu
Office Hours: TBD (or by e-mail appointment)
Role: Lectures, exams.

Prof. Marco Duarte
Contact: Office: Marcus Hall 215I, Phone: 545-8583, e-mail: mduarte@ecs.umass.edu
Office Hours: TBD (or by e-mail appointment)
Role: Recitations, homework, quizzes.

"Where Everybody Knows Your Name": We will try to learn everybody's name, although you may have to remind us two or three times before we get it. Please come by our office hours during the first two weeks of the semester so that we can meet you.

Prerequisites: ECE 212.

Textbook: None required. I will provide pointers to reading in *Linear Systems and Signals, Second Edition*, by Lathi (Oxford University Press), but it is not required.

Grading: Homework - 15 %
Quizzes - 15 %
Midterm Exam 1 (Date: October 15, Time: 7pm-9pm, Place: TBD) - 20 %
Midterm Exam 2 (Date: November 14, Time: 7pm-9pm, Place: TBD) - 20 %
Final Exam - 30 %

All exams will be closed-book closed-notes, and calculators will **not** be allowed; however, a single **hand-written** formula sheet will be allowed. The final exam will be cumulative. Homeworks will be collected at the beginning of the **lecture** on the date that they are due. Late homeworks will not be accepted.

Ground Rules: You are allowed to work together on homeworks; however, each student must submit his/her own solutions. Also recall that homeworks are really only preparation for the exams, so do not rely too heavily on other students for help. **Academic dishonesty** (either taking or giving answers on an exam, use of extra crib sheets, theft of another's work, etc.) will be dealt with harshly; you will receive an "F" for the course, and there may be further disciplinary action.

Rough Course Outline

0. Motivation
I. Continuous-Time (CT) Signals
    A. Review of Complex Numbers (in recitation)
    B. Basic Time-Domain Signals
        1. Review of Simple Signal Operations
        2. Signal Properties
        3. Some Useful Signals
II. Continuous-Time Systems
    A. The Box - how do you characterize?
    B. System properties: linearity, time-invariance, causality
    C. LTI system analysis in the time domain
    D. LTI system analysis in the frequency domain; the Fourier transform
        1. Introduction and properties
        2. Application to systems: frequency response, input-output relations
        3. Filter types and designs
        4. Applications to communications
III. Discrete-Time (DT) Signals and Systems
    A. Sampling
        1. Nyquist rate and aliasing
        2. Reconstruction
        3. Time-domain properties of DT signals
    B. The Discrete-Time Fourier Transform (DTFT)
        1. Introduction
        2. Relation of CT and DT transforms
    C. Discrete-Time Systems
        1. Impulse response and convolution
        2. Frequency-domain analysis of DT systems
        3. Filter types and designs
        4. DT implementations of CT systems
    D. The Discrete Fourier Transform (DFT)
        1. Relation to DT and CT Fourier transforms
        2. Use in system implementations