EEL 4514 - Communication Systems and Components

Dr. John M. Shea

Spring 2005

Pre-requisite: EEL 3112 and EEL 3135

I expect the following:

- Ability to work and learn independently. Course material may be assigned that is not covered in class but will be evaluated on the homework and the exams. Pop quizzes may be given that test the fundamentals of material covered in class, even before homework is given on that material.

- Ability to apply fundamental techniques to solve new problems. Homework problems will be chosen to both strengthen the understanding of the fundamentals and to teach the application of the fundamental techniques to new problems. Exams will be designed to test the depth of understanding of the fundamentals and the ability to apply these techniques to new problems.

- Understanding of systems theory, including convolution, Fourier transforms, and impulse functions.

- Strong mathematical background, especially differentiation, integration, and working with trigonometric functions.

- Knowledge of elementary circuit theory, including transfer function concepts.

Computer requirement: Some problems will require MATLAB. Students may want to purchase the student version of MATLAB, as departmental computer resources are limited. Not being able to get on a computer is not a valid excuse for late work.

Meeting Time: Tuesday Period 4 (10:40-11:30) and Thursday Periods 4-5 (11:45-12:35)
Meeting Room: NEB 202
Final Exam: 27D, 3:00 PM – 5:00 PM, Wednesday, April 27th

E-mail: jshea@ece.ufl.edu
Class Web page: http://wireless.ece.ufl.edu/eel4514
Personal Web page: http://wireless.ece.ufl.edu/jshea
Office: 439 New Engineering Building
Phone: (352)846-3042
Office hours: Tuesday and Thursday 2:00-3:00 and by appointment

Textbook:

Additional References:


Teaching assistant: Matthew Rappaport, wireless@ufl.edu, Office hours to be announced

Course Topics (as time allows)

• Intro to Communications
  – History and survey of communications
  – Fundamentals of communication systems
  – Analog vs. digital information and communication
  – Communication Channels

• Signals and Spectra: Chapters 2 and 3
  – Time averages
  – Energy and power signals
  – Decibel measurements
  – Fourier transforms
  – Bandwidth
  – Digital representation of bandlimited signals
  – Complex baseband representation of bandpass signals
  – Linear time-invariant filtering
  – Equivalent low-pass filter

• Baseband analog communication
  – APPLICATION: POTS (plain-old telephone service)

• Bandpass analog communication: Chapters 4 and 5
  – Amplitude Modulation (AM)
  – Frequency Modulation (FM)
  – Phase Modulation (PM)
  – APPLICATION: Radio & Television Broadcasting
  – APPLICATION: AMPS analog mobile phone system
• Sampling and Pulse Modulation: Chapter 6
  – Pulse Amplitude Modulation (PAM)
  – Pulse Code Modulation (PCM)
  – APPLICATION: T1 telephone line

• Baseband Digital Modulation: Sections 7.1, 7.2, App. C, 7.6, 7.7, 7.9
  – Line codes
  – Gram-Schmidt orthogonalization
  – Receiver design
  – Error probabilities
  – APPLICATION: USB
  – APPLICATION: Ethernet
  – Intersymbol Interference
  – Time-division multiplexing (TDM)
  – APPLICATION: T1 telephone line revisited

• Bandpass Digital Modulation: Sections 7.8, 9.1, 9.2
  – Common I-Q modulations
  – Minimum-shift keying and GMSK
  – APPLICATION: GSM cellular system
  – OFDM
  – APPLICATION: 802.11a/g wireless LAN
  – Spread spectrum
  – APPLICATION: 802.11b wireless LAN
  – APPLICATION: IS-95 cellular system

Goals and Objectives: Upon completion of this course, the student should be able to

• Work with common equations for propagation and be able to answer questions about different propagation modes
• Translate between signals or impulse responses and their Fourier transforms
• Represent analog signals by digital signals that are sufficient to capture all the information and behavior of the analog signals
• Determine bandwidth
• Translate between bandpass and complex baseband representations for signals and filter responses
• Perform filtering in the time and frequency domains
• Identify pros and cons of common analog and digital communication techniques
• Perform system-level design of receivers for common modulations
• Identify key techniques used in many communication systems and discuss the advantages and disadvantages of these techniques
• Compare digital modulations based on bandwidth- and energy-efficiency

Grading: Grading will be based on two midterm exams (25% each), one final exam (30%), homework and short quizzes (15%), and participation (5%). The participation score will take into account in-class participation, e-mail exchanges, discussions outside of class, etc. If your cell phone rings during class, I may deduct points from the class participation score.

A grade of > 90% is guaranteed an A, > 80% is guaranteed a B, etc. Homework will be accepted late up to two times, with an automatic 25% reduction in grade. Bonus points may be awarded on some exams or for optional projects. No formal project is required, but, as mentioned above, students will be required to use MATLAB in solving some homework problems. When students request that a submission (exam or homework) be regraded, I reserve the right to regrade the entire submission rather than just a single problem.

Attendance: Attendance is not mandatory. However, students are expected to know all material covered in class, even if it is not in the book. Furthermore, the instructor reserves the right to give unannounced “pop” quizzes with no make-up option. Students who miss such quizzes will receive zeros for that grade. If an exam must be missed, the student must see the instructor and make arrangements in advance unless an emergency makes this impossible. Approval for make-up exams is much more likely if the student is willing to take the exam early.

Academic Honesty:

All students admitted to the University of Florida have signed a statement of academic honesty committing themselves to be honest in all academic work and understand that failure to comply with this commitment will result in disciplinary action.

**The Honor Code:** We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honesty and integrity.

**Pledge:** On all work submitted for credit by students of the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment."

This statement is a reminder to uphold your obligation as a student at the University of Florida and to be honest in all work submitted and exams taken in this class and all others. Honor statements on tests must be signed in order to receive any credit for that test.

Collaboration on homework is permitted unless explicitly prohibited, provided that:

1. Collaboration is restricted to students currently in this course.
2. Collaboration must be a shared effort. I.e., it is not permissible to copy someone else’s work.
3. Each student must write up his/her homework independently.

4. On problems involving MATLAB programs, each student should write their own program. Students may discuss the implementations of the program, but students should not work as a group in writing the programs.

5. It is cheating to use solutions from students outside of this class or from solutions manuals.

I have a zero-tolerance policy for cheating in this class. If you talk to anyone other than me during an exam, I will give you a zero. If you plagiarize (copy someone else’s words) or otherwise copy someone else’s work, I will give you a failing grade for the class. Furthermore, I will be forced to bring academic dishonesty charges against anyone who violates the Honor Code.

ADA Statement:

The University of Florida provides high-quality services to students with disabilities, and we encourage you to take advantage of them. Students with disabilities needing academic accommodations should 1) Register with and provide documentation to Disability Resources (392-1261), and 2) Bring a letter to the instructor from this office indicating that you need academic accommodations. Please do this as soon as possible, preferably within the first week of class.