ECE 5325/6325, Wireless Communication Systems, Fall 2011

Lecture: Tuesday and Thursday, 3:40 PM - 5:00 PM in WEB L120

5325 Pre-req: C- or better in ECE 3300 (Fundamentals of Electromagnetics and Transmission Lines), or equivalent.

6325 Pre-req: C- or better in ECE 3300 and ECE 3500 (Signals & Systems), or equivalent.

Credit: 3 hours

Instructor: Neal Patwari

Office: MEB 3120

Office Hours: Wed 9:30-11am, Thursday 1:00-2:30pm, and by appointment

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Grader: Nikita Raje, nikita.raje@utah.edu

TA office hours, time and location t.b.a.

Web Page: There are two. The main page is http://span.ece.utah.edu/5325. The other is UOnline/Blackboard, http://uonline.utah.edu/, which is used to post grades, some handouts, and for online submission of your work.

Textbook: Theodore S. Rappaport, Wireless Communications: Principles and Practice, Prentice Hall, 2nd edition, 2002. This book has been around for a while, so please check for used copies, which I've seen online in the $60 range. The 3rd chapter is available as pdf on WebCT, in case you need more time for shipping. Other readings (needed because of the age of the Rappaport book) are posted on the class schedule online.

Grading ECE 5325 and ECE 6325 are graded separately, on different scales.

ECE 5325 course grading will be calculated based on:

- Portfolio: 8%
- Exam 1 (in class, Tue. Sept. 20): 24%
- Exam 2 (in class, Tue. Oct. 25): 24%
- Exam 3 (in class, Thu. Nov. 17): 24%
- System Design Competition, Report and Presentation 20%

ECE 6325 course grading will be calculated based on:

- Portfolio: 8%
- 6325 Assignments: 12%
- Exam 1 (in class, Tue. Sept. 20): 20%
- Exam 2 (in class, Tue. Oct. 25): 20%
- Exam 3 (in class, Thu. Nov. 17): 20%
- System Design Competition, Report and Presentation 20%
Exams: Exams 1, 2, and 3 are in class, one hour exams (3:40-4:40). The final exam period, Thu. Dec 15, 3:30-6:30pm, is your chance to retake any of the exams. Three exams, corresponding to the same material covered in exams 1, 2, and 3, are offered during the final exam period. You may take or not take any of these three; your final score on any exam is the maximum of the score you received for the in class exam and for the final exam. (This is an exam system adapted from Prof. Furse). Please note that the full exam period is three hours in order to allow retake of all three exams. Also note that the exams for 5325 and 6325 differ – some questions will be on both exams, and others will appear on the 5325 but not the 6325 exam, and vice versa. I expect 6325 students to have a more in-depth understanding of the course material.

Portfolio: Your portfolio is YOUR written notes that you may use on the exams. Each day you will be asked to answer a question associated with the lecture and do 2-4 related homework problems. The question might be “How do you compute the required transmit power?” Your writing in your portfolio for that day should include instructions (to yourself) on how to answer the homework questions, in addition to your solutions. The instructions (typically about a page) should be written so YOU can understand them. Exams will be open portfolio, closed book, so include everything (equations, description of terms, special cases, etc.) you need to solve the problems. You may include tables and figures copied from the text, but don’t copy the text itself. Portfolios will be turned in (typically on a Thursday by 3:40pm), and graded for completeness only. To help the grader do this quickly, please turn in the portfolio in order of the questions listed on the assignment. You are responsible for checking your own homework solutions. Solution manuals are available from the TA or at the Marriott Library Reserve. Portfolios may be in any notebook you wish but must be held together. A 3-ring binder is suggested.

Collaboration Policy: You are encouraged to work together on portfolio questions whenever possible. Discussing problem solving approaches and techniques is a great way to learn. After making a genuine attempt to solve the problems, you are encouraged to discuss the answers with other students currently enrolled in ECE 5510 to check the answers and compare solution approaches. However, after such a discussion, you should write your answers on your own, in a way that makes sense to you, without copying to the solutions of other students. Otherwise, your portfolio won’t help you during an exam.

Team Design Competition: You will work in a team (2-3 members per team) to develop an end-to-end wireless communication system for a specific purpose. This semester, you will design a “system for text message communication after a major disaster”, as described in detail on the course website. You will write a report on your system design, and do a 10 minute presentation in front of the class. The designs from all teams will be judged by your fellow students (5325 teams will be judged by 6325 students; 6325 teams will be judged by 5325 students.) The report and presentation will also be separately judged by the instructor. Your grade will be 50% based on your peer student rating, and 50% the instructor’s rating.
6325 Info: The exams for 6325 share about 75% of questions with the exams for 5325 students. Projects for 6325 students are expected to include more detailed results, as compared to those from 5325. Students in 6325 are expected to complete three additional Matlab-based assignments, among the several listed on the web site (as “6325-only assignments”), which investigate in more depth the topics covered in the homework.

Cheating Policy: Copying on exams, or plagiarism on projects, is cheating. Please see the cheating policy on the web site for more information. Plagiarism is copying or paraphrasing someone else’s ideas from any source (book, article, web, ...) without citation. Please use citations when writing; there is no reason not to do so, and plagiarism will result in a grade of ‘0’ on the assignment, and perhaps more serious penalties. Written reports are automatically checked using plagiarism detection software.

Reserve: Several books are at the library reserve desk for 2 hour / 1 day loan.

Tips:

1. Find another student or students to help you (or to help them) when you (they) have trouble with homework problems. Do that from the start!

2. Read the corresponding section in the book before lecture.

3. When you do not fully understand a topic in lecture or in the homework come to office hours as soon as possible. Topics build on each other, so you want to be sure not to fall behind – the longer you wait, the tougher it will be to catch up.

4. Do additional problems, beyond the homework.

5. Read ahead to topics that interest you, and plan ahead for your project.

Disability Accommodations The University of Utah seeks to provide equal access to its programs, services and activities for people with disabilities. If you will need accommodations in the class, reasonable prior notice needs to be given to the Center for Disability Services, 162 Olpin Union Building, 581-5020 (V/TDD). CDS will work with you and the instructor to make arrangements for accommodations. All written information in this course can be made available in alternative format with prior notification to the Center for Disability Services.
Learning Objectives:

1. Topics related to cellular systems and other wireless networks:
   (a) Understand how a cellular system functions.
   (b) Understand multiple access / duplex protocols (time division, frequency division, code division)
   (c) Compute the number of users a particular system can accommodate.
   (d) Design / calculate a link budget and S/I ratio for a cellular system.
   (e) Design a system for increased capacity using trunking, cell splitting, directional antennas, downtilt, etc.
   (f) Understand basic multiple-access control (MAC) protocols

2. Topics related to physical multipath channels:
   (a) Understand transmission, diffraction, reflection, scattering, and large-scale fading
   (b) Understand multipath fading (small-scale, frequency-selective, temporal)
   (c) Understand and use Raleigh and Rician fading models
   (d) Understand the Doppler effect

3. Topics related to modulation techniques and diversity techniques: Describe, analyze, and understand engineering tradeoffs of the following with energy-limited devices and fading channels.
   (a) Digital modulations, including PSK, FSK, PAM, QAM; OQPSK, $\pi/4$ QPSK, MSK, GMSK
   (b) Spread-spectrum systems (DS-SS, FH-SS)
   (c) Orthogonal frequency division multiplexing (OFDM) systems
   (d) Multiple antenna systems including MIMO
   (e) Calculate the fading margin and diversity gain from combining schemes
   (f) Understand how to implement block coding and cyclic redundancy checking