



## ECE 5325/6325, Wireless Communication Systems, Spring 2010

- Lecture:** Tuesday and Thursday, 3:40 PM - 5:00 PM in WEB L102
- Prerequisite:** ECE 3300 (Electromagnetics), ECE 3500 (Signals and Systems), or equivalent.
- Credit:** 3 hours
- Instructor:** Neal Patwari
- Office:** MEB 3120
- Office Hours:** Monday 4-5pm, Tuesday 9:30-10:30am, Thursday 10am-noon, and by appointment
- Email:** [npatwari@ece.utah.edu](mailto:npatwari@ece.utah.edu)
- Phone:** (801) 581-5917
- Grader:** Jordan Kemp, [jordan.kemp@utah.edu](mailto:jordan.kemp@utah.edu)  
TA office hours in 2350 MEB, time: t.b.a.
- Web Page:** There are two. The main page is at <http://span.ece.utah.edu/>, under Teaching: ECE 5325/6325. This page links to WebCT/Blackboard, <http://webct.utah.edu/>, which is used to post grades, handouts, and lecture notes.
- 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.
- Grading** Course grading is adapted from Prof. Cynthia Furse.  
ECE 5325 and ECE 6325 are graded separately, on different scales.  
ECE 5325 course grading will be calculated based on:  
Portfolio: 10%  
Project Report and Presentation (Thu. April 22): 15%  
Exam 1 (in class, Tue. Feb. 9): 25%  
Exam 2 (in class, Tue. Mar. 9): 25%  
Exam 3 (in class, Thu. Apr. 15): 25%  
ECE 6325 course grading will be calculated based on:  
Portfolio: 10%  
6325 Assignments: 10%  
Project Report and Presentation (Thu. April 22): 20%  
Exam 1 (in class, Tue. Feb. 9): 20%  
Exam 2 (in class, Tue. Mar. 9): 20%  
Exam 3 (in class, Thu. Apr. 15): 20%

- Exams:** Exams 1, 2, and 3 are in class, one hour exams (3:30-4:30). The final exam period, **Wed. May 5, 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 handed out 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. Please note that the full exam period is three hours in order to allow retake of all three exams.
- Portfolio:** 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 power required for transmission?" Your portfolio for that day should include instructions on how to determine the power followed by the homework problems assigned to practice this. The instructions (typically about a page) should be written so YOU can understand them. Exams will be open portfolio, closed book, so include everything 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. 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 with an index in the front and each page or section clearly numbered. 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.
- Project:** This course requires an individual project writeup and 10-15 minute presentation, in which you will further develop a topic of interest in the area of wireless communications systems (details provided separately). A wireless symposium will be held on Thu. April 22, between 3:40-7:40. You must present (10-15 minutes) and attend six other presentations during this symposium.
- 6325 Info:** Students taking 6325 are expected to have taken a probability class, such as ECE 5510. 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, 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 projects 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 multiple access / duplex protocols (time division, frequency division, code division)
  - (b) Understand how a cellular system functions.
  - (c) Compute the number of users a particular system can accommodate.
  - (d) Compute the required S/I ratio for a system.
  - (e) Design a system for increased capacity using trunking, cell splitting, directional antennas, etc.
2. Topics related to physical multipath channels:
  - (a) Understand transmission, diffraction, reflection, and large-scale fading
  - (b) Understand multipath fading (small-scale, frequency-selective, temporal)
  - (c) Understand and use Rayleigh 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