EE 8510 - Advanced Topics in Communications: Multi-User Information Theory Spring 2005

Course Information

Instructor: Nihar Jindal, 6-119 EE/CS, nihar@ece.umn.edu, 625-6306

Class Time and Location: Tuesday & Thursday, 4:00 - 5:15, Ackerman 211

Class Webpage: http://www.ece.umn.edu/class/ee8510/index.html

Text: There is no required textbook for this course, but it is **highly recommended** that students have an information theory textbook, preferably one used for an introductory graduate course in information theory. The book *Elements of Information Theory* by T. Cover and J. Thomas (Wiley-Interscience, 1991) is highly recommended. Course notes will also be regularly handed out.

Prerequisites: EE 5581 or an equivalent information theory course. If you have not taken such a course, please speak with the instructor.

Homework: There will be (approximately) seven homework assignments, almost entirely during the first half of the course. Assignments will be given on an approximately weekly basis during the first half of the course, and there may be one or two assignments during the second half of the course.

Exam: There will be a midterm examination in the middle of the course (most likely before spring break).

Project: A research project is a required portion of this course. The project can either be an in depth study of a relevant topic, or an original research idea. Each student will give a short project presentation at the end of the course.

Grading Policy: Final grade will be 35% Homework, 25% Midterm, and 40% Project.

Course Outline

1. **Information Theory Basics** (4 lectures)
   Entropy, mutual information, AEP, Source & Channel Coding Theorems

2. **Single User Gaussian Channels** (4 lectures)
   AWGN Channel, Parallel Channels, Fading Channels, MIMO

3. **Multiple-Access Channel** (3 lectures)
   Discrete Memoryless, Gaussian, MIMO, Slepian-Wolf Coding, MAC with Correlated Sources

4. **Broadcast Channel** (4 lectures)
   Discrete Memoryless, Degraded, Gaussian, MIMO

5. **Interference Channel** (1 lecture)
   Discrete Memoryless, Strong & Very Strong Interference, Gaussian

6. **Relay Channel** (2 lectures)
   Discrete Memoryless, Degraded, Gaussian

7. **Rate-Distortion Theory** (2 lectures)
   Discrete Memoryless, Gaussian

8. **Ad-Hoc & Sensor Networks** (4 lectures)
   Capacity Scaling, Distributed Estimation/Detection, CEO Problem, Joint Source/Channel Coding

9. **Network Coding** (3 lectures)
   Linear Coding, Algebraic Coding

Other potential topics include: Channels with State, Feedback Channels, Distributed Source Coding (Wyner-Ziv), Multiple Description Coding, Method of Types