

# Multiuser Information Theory and Wireless Communications\*

**Professor in Charge:** Toby Berger (Rhodes 392).

**Principal Lecturer:** Jun Chen (Rhodes 391, jc353@cornell.edu).

**Credits:** 1-2 credits.

**Prerequisite:** ECE 562.

**Office Hour:** Available upon appointment.

**Organizational Meeting:** RH380, 2:00pm -3:40pm, Jan. 31, 2005. We will decide the course time during this meeting. People who are interested in this course but not available for the organizational meeting should send email to jc353@cornell.edu specifying other afternoon times that work for you.

## General Description:

This is a graduate level course on multiuser information theory and wireless communications. Besides covering the fundamental results in network information theory, we will emphasize the connections between source coding and channel coding, and various notions of channel capacity in wireless communications.

## Minimum Syllabus:

1. Review channel coding theory and rate distortion theory.
2. Capacity analysis of MIMO systems.
3. Multiaccess channels.
4. Distributed source coding: Slepian-Wolf, Wyner-Ziv, Berger-Tung.
5. Gelfand-Pinsker theorem and Costa's dirty paper coding.
6. Broadcast channels: Marton's region and dirty paper precoding.
7. Multiple descriptions.
8. Resource allocation in multiaccess communication systems and distributed compression systems.

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\*An ECE 600 or 700 course number will be assigned to this course soon.

9. Rate splitting and source splitting.
10. Duality between multiaccess channels and broadcast channels.

### **Optional Topics:**

The minimum syllabus takes up much of the available time. We will spend the remaining time giving an informal introduction to one or more of the following, depending on the available time and the preferences of the audience.

1. Diversity-multiplexing tradeoff in MIMO channels.
2. Noncoherent MIMO channels.
3. Network coding.

### **References:**

1. T. M. Cover and J. A. Thomas, *Elements of Information Theory*. New York: Wiley, 1991.
2. R. Gallager, *Information Theory and Reliable Communication*, John Wiley and Sons, Inc., 1968.
3. R. Yeung, *A First Course in Information Theory*, Kluwer Academic/ Plenum Publishers, 2002.
4. D. Tse and P. Viswanath, *Fundamentals of Wireless Communication*, to be published by Cambridge University Press. Online: <http://degas.eecs.berkeley.edu/dtse>
5. T. Berger, "Multiterminal source coding," in *The Information Theory Approach to Communications* (G. Longo, ed.), vol. 229 of *CISM Courses and Lectures*, pp. 171-231, Springer-Verlag, Vienna/New York, 1978.

### **Homework and Exam:**

No formal homework assignments, no exams. Instead, We will give many open problems. Students who take one credit shall submit a report on one of the topics covered in the course. Students who take two credits can choose to either give a presentation or write a conference paper on a topic related to the course.