

University of Notre Dame  
Department of Electrical Engineering

EE-698G: ADVANCED TOPICS IN MULTIUSER COMMUNICATIONS

Course Information  
Spring 2003

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## Instructor

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## Overview

Welcome! *EE-698G: Advanced Topics in Multiuser Communications* is a discussion based graduate course exploring advanced topics in multiuser communications, signal processing, and information theory. Objectives for the course are to develop understanding of the basic models, fundamental performance limits and tradeoffs, and practical approaches for communication in these environments. Interaction and cross-fertilization of ideas from different research areas will also be emphasized. A successful course will allow students to become aware of multiuser issues, digest research papers in the area more readily, and interact with other researchers more fluently.

Each class will be an informal, tutorial-style presentation and discussion led by one of the graduate students, with the remaining students participating in the discussion. A written summary of the class topic, with examples and key references, will be distributed one week before the presentation. The professor's role is to help enrich, but not direct, the discussion, and to assign grades based on each student's summary, presentation, and class participation.

## Prerequisites

The un-official but important prerequisites for EE-698G are at least two of the following: *EE-553: Advanced Digital Communication*, *EE-653: Information Theory*, and *EE-671: Detection and Estimation*—or their equivalents. As a discussion based course, EE-698G will be more forgiving of the prerequisites than a typical lecture course. Nevertheless, the course will require a high-level of maturity, decication, and committment to understanding the material in depth.

## Meeting Times

Meeting days and times will be:

Meetings: Tuesdays and Thursdays, 12:30pm–1:45pm, 143 DeBartolo Hall

Our meetings will work best (and are most fun) when they are highly interactive, so your participation is important and strongly encouraged. Remember that asking questions in class is a sign of engagement in the material, not an expression of weakness!

## Proposed Roles and Responsibilities

In lieu of problem sets and exams, and subject to sufficient registration, each class member can lead the discussion for one (or more) weeks. For that week, he or she reviews literature on a specific topic (with faculty assistance as required), selects one or two key papers and produces a written summary suitable for distribution to the class, and leads a tutotial-style survey of the subject during class. It is the responsibility of all other members of the class to read the summary and papers, attend class, and participate in the discussion. To allow for sufficient preparation, the summary and papers must be distributed at least one week before the presentation.

## Course Grade

Your course grade will be based upon my best assessment of your participation and level of engagement with the material during the semester. Roughly, the weights used in the grade assignment will be:

Summary	20%
Presentation	20%
Attendance	30%
Participation	30%

Although the focus of the course is obviously learning, not grades, I know the course grade is important to you, and I want you to know that I take the process seriously.

## Course Materials, Webpage, and E-mail List

Materials—*e.g.*, handouts, summaries, papers, and so forth—will be made available on the course webpage at:

<http://www.nd.edu/~jn1/ee698g/>

In addition to making announcements during lecture, we may make announcements using e-mail. The course e-mail list is:

[ee698g-01-sp03@listserv.nd.edu](mailto:ee698g-01-sp03@listserv.nd.edu)

All announcements will be archived at:

<http://listserv.nd.edu/archives/ee698g-01-sp03.html>

By registering for the course, you should automatically be a member of the e-mail list. If this is not the case, please let me know.

## Possible Topics

Depending upon the interest of the students, and subject to sufficient enrollment, the following topics may be covered:

- Background (Prof. Laneman, as necessary)
  - Detection theory
  - Information theory
  - Wireless communication
- “Simple” Multiuser Channels Models
  - Multiple-Access Channel
  - Broadcast Channel
  - Interference Channel
  - Two-Way Channel
  - Relay Channel
- Multiuser Channel Coding
  - Multiuser Detection & Decoding
  - Superposition Coding, Stripping
  - Power Control, Multiuser Diversity
  - Channel State Information, Feedback
  - Network Coding
- Multiuser Source Coding
  - Slepian-Wolf Coding
  - Wyner-Ziv Coding
  - The CEO Problem
  - Multiple Descriptions
  - Successive Refinement
- Multiuser Joint Source-Channel Coding
- Connections to Singleuser Systems

## References

In addition to many articles in, among other journals, the *IEEE Trans. on Communications*, *IEEE Trans. on Signal Processing*, and *IEEE Trans. on Information Theory*, the following books are useful starting points to and references for the material. A complete reference list will evolve on the course web site throughout the semester.

1. T. M. Cover and J. A. Thomas, *Elements of Information Theory*, John Wiley & Sons, Inc., 1991.
2. T. S. Rappaport, *Wireless Communications: Principles and Practice*, Prentice Hall, 2001.
3. W. Stallings, *Wireless Communications and Networks*, Prentice Hall, 2001.
4. S. Verdu, *Multiuser Detection*, Cambridge University Press, 1998.
5. S. Verdu and S. W. McLaughlin (Eds.), *Information Theory: 50 Years of Discovery*, Wiley-IEEE Press, 1999.
6. A. J. Viterbi, *CDMA: Principles of Spread Spectrum Communication*, Prentice-Hall, 1995.