EURECOM

MobCom - Mobile Communications Techniques

Syllabus – Fall 2024

Instructor: Prof. Petros Elia
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Class Location and Time: Lecture room 102, Thursday: 8:45am-11:45am

Office Hours: Thursday 12:00-13:00: Room 329 (or via zoom, same hours)

Course Pre-requisites:
An understanding of probability theory, random processes, transform theory, and digital communications is useful.

Suggested Text Book:

Fundamentals of Wireless Communication, by D. Tse and P. Viswanath, Cambridge University Press, May 2005.

A leading textbook providing a unified view of wireless communications. Some lectures will follow the outline of the text, placing emphasis on the first seven chapters. Different topics will be drawn from different sources, from the suggested books described below.

Course Objectives:

To provide a fundamental understanding of mobile communication systems. The course will seek to describe the key aspects of channel characteristics/modeling, of communication techniques, and to describe the application of these techniques in wireless communication systems. The course will cover recent research developments, such as opportunistic communications, basic aspects of MIMO communications, and OFDMA. Specific topics will include basic properties of multipath fading, diversity techniques, multiple access and interference management, fundamental capacity exposition and opportunistic communications. Emphasis will also be paid on coding, and different classical and modern techniques that help us understand how some of the capacity results that we had can be achieved in practice. Emphasis will be given on classical and convolutional codes, and some aspects of other advanced codes will also be covered.

Grading:

Final exam:	Early February	40%
Midterm exam	Nov.-Dec.	25%
MATLAB + Research sessions		25%
Homeworks		10%

Exams:

The Final Exam will be two hours long, and it will be comprehensive. During the final exam, all notes from this taught class are allowed.
The midterm exam will be smaller (1→1.5 hours).

Course Outline:

Physical channel modeling
Input/output channel models
Time and frequency channel coherence: Doppler spread, coherence time, delay spread and coherence bandwidth
Statistical channel modeling

Detection in fading channels
Degrees of freedom
Effects of channel uncertainty
Diversity techniques: Time diversity, antenna diversity, freq. diversity, space-time codes
OFDM

Capacity of AWGN and fading wireless channels
Multiuser capacity and opportunistic communications

- Uplink
- Downlink

Coding aspects

-Linear Codes for different channels including the AWGN channel
- Codes achieving capacity in various channels
- Convolutional Codes
- Basics of Polar codes.

Recommended Text books and papers:

D. Tse and P. Viswanath, "Fundamentals of Wireless Communication," 2005.
T. Cover and J. Thomas, "Elements of Information Theory," 1991.
Proakis, John G., *"Digital Communications, Fourth Edition,"*, 2001.
Papoulis and Pillai , *"Probability, random variables and stochastic processes,"* 2002.

More recommended books can be found in the library's MOBCOM portal