EPFL

COM-510   **Advanced digital communications**

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Cursus	Sem.	Type
Communication systems minor	H	Obl.
SC master EPFL	MA1, MA3	Obl.

Language of teaching	English
Credits	7
Session	Winter
Semester	Fall
Exam	Written
Workload	210h
Weeks	14
Hours	**6 weekly**
Courses	4 weekly
Exercises	2 weekly
Number of positions	

Summary

Digital communication systems are basic workhorses behind the information age. Examples include high-speed wired and wireless networks, but also CDs, hard drives, and flash memory. This class presents the tools and concepts behind present and emerging systems, including OFDM, GSM, 3G, and 4G/LTE.

Content

Digital communication systems are basic workhorses behind the information age. Examples include high-speed wired and wireless networks, but also storage technologies such as CDs, hard drives, and flash memory. Yet another example is the Global Positioning System (GPS), which is also based on digital communications. This course is an introduction to the foundational principles underlying the design and analysis of digital communication systems. Principled approaches and mathematical sophistication have had an exceptionally profound impact on the development of these systems. The class will provide the student with a command of the tools and concepts behind present and emerging systems, including OFDM, GSM, 3G, 4G/LTE, and more.

1. Foundations of Signalling, Detection and Estimation (3 weeks)
2. Wired Communication: OFDM, the foundations behind ADSL and beyond (3 weeks)
3. Wireless Communication: Diversity and the foundations behind LTE/4G Wireless and emerging wireless technologies, including multi-user communication (4 weeks)
4. Coding Techniques (3 weeks)

Keywords

Wireless, OFDM, ADSL, Fading, Diversity, Coding, Modulation, Multi-user communication, GSM, 3G, 4G, LTE

Learning Prerequisites

Required courses

"Principles of Digital Communications"

Recommended courses

"Circuits and Systems" / "Signals and Systems" (in particular, Fourier and Z-transforms).
"Linear Algebra" (concepts of matrices, vectors, eigenvalues)

Important concepts to start the course

Basic familiarity with Fourier transforms, vectors, matrices and eigenvalues, will be an advantage in this class.

Learning Outcomes

By the end of the course, the student must be able to:

- Assess / Evaluate an ADC (advanced digital communication) system (data rate, spectral bandwidth, energy requirements, error probability, implementation complexity)
- Design an ADC system (data rate, spectral bandwidth, energy requirements, error probability, implementation complexity)
- Formalize an ADC system (data rate, spectral bandwidth, energy requirements, error probability, implementation complexity)
- Model physical properties of wired and wireless communication channels

Teaching methods

1. Lectures (using blackboard and projector), 4h per week
2. Exercise session, 2h per week

Expected student activities

There will be weekly homework assignments, with the following emphasis:
1. Paper-pencil studies of communication system design (70%)
2. Matlab (or other numerical tools) to evaluate performance (30%)

Assessment methods

1. Homework / Project
2. Midterm Exam
3. Final Exam

Supervision

Office hours	Yes
Assistants	Yes
Forum	Yes

Resources

Bibliography

There is a plethora of books on the topic of Digital Communications. The class will give specific pointers, also via the lecture notes that will be distributed in class.

Ressources en bibliothèque

- Digital Communications / Proakis
- Principles of Digital Communication / Gallager
- Fundamentals of Digital Communication / Madhow
- A Foundation in Digital Communication / Lapidoth

Notes/Handbook

A set of lecture notes will be provided to the students at the beginning of the class.

Websites

- http://ipg.epfl.ch/cms/lang/en/pid/136515

Moodle Link

- http://moodle.epfl.ch