COM-430 **Modern digital communications: a hands-on approach**

Chiurtu Nicolae

Cursus	Sem.	Type
Communication systems minor	H	Opt.
Computer science	MA1, MA3	Opt.
Cybersecurity	MA1, MA3	Opt.
SC master EPFL	MA1, MA3	Obl.

Language of teaching	English
Credits	8
Session	Winter
Semester	Fall
Exam	During the semester
Workload	240h
Weeks	14
Hours	**4 weekly**
Lecture	2 weekly
Practical work	2 weekly
Number of positions	

Summary

This course complements the theoretical knowledge learned in PDC with more advanced topics such as OFDM, MIMO, fading channels, and GPS positioning. This knowledge is put into practice with hands-on exercises based on Matlab or Python (at choice) and on a software-defined radio platform.

Content

1. Software radio : key concepts.
2. Matlab/Python implementation of the signal processing chain to the level of detail taught in Principles of Digital Communications (PDC: COM-302).
3. Channel modeling, estimation, equalization.
4. Implementation of a basic wireless communication system using a software-defined radio testbed.
5. Fading and diversity.
6. OFDM and MIMO : theory and implementation.
7. CDMA in the context of a GPS system.
8. Decoding of a GPS signal and positioning.

Keywords

Wireless, OFDM, Diversity, Coding, GPS, CDMA, MMSE, Rayleigh fading, software-defined radio, channel estimation.

Learning Prerequisites

Required courses

COM-302 Principles of Digital Communications (PDC) or equivalent.

Important concepts to start the course

Solid understanding of linear algebra and probability as well as real and complex analysis.

Learning Outcomes

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

- Design and implement and advanced digital communication system (data rate, spectral bandwidth, energy requirements, error probability, implementation complexity)
- Model physical properties of wired and wireless communication channels
- Implement various parts of a "physical-layer" digital communication system

- Understand what software-defined radio is all about
- Design and implement an advanced digital communication system (data rate, spectral bandwidth, energy requirements, error probability, implementation complexity).
- Model the physical properties of wired and wireless communication channels.
- Implement various parts of a "physical-layer" digital communication system.
- Understand what software-defined radio is all about.

Teaching methods

Ex cathedra lectures and small projects.

Expected student activities

Follow lectures; guided as well as independent work on projects.

Assessment methods

Written and practical midterm and final exam during the semester.
40% midterm exam, 60% final exam.

Supervision

Office hours	Yes
Assistants	Yes
Forum	Yes

Resources

Notes/Handbook

Lecture notes

Moodle Link

- https://go.epfl.ch/COM-430