

University of Athens
Advanced Class on Digital Modems
Spring 2005

Home Page: <http://wireless.phys.uoa.gr/education/index.html>

Instructors: Professor Andreas Polydoros, Assistant Professor Aris Moustakas

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Location: Graduate Classroom R/H, Department of Physics

Time: Tuesdays 4:00 pm - 6 pm.

Course Assistant: Andreas Zalonis

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Final Examination: 45-minute presentation (powerpoint)

Daily Lecture Notes: will be uploaded on the above website.

Prerequisites: The previous-semester class on digital modems.

Excellent Recommended Texts :

J. Proakis, *Digital Communications*, Mc-Graw Hill, 1989.

B. Sklar, *Digital Communications, Fundamentals and Applications*, Prentice Hall, 2001, 2nd Ed.

E. Lee and Messerschmitt, *Digital Communication*, Kluwer, 1988.

M. Simon, S. Hinedi and W. Lindsey, *Digital Communication Techniques: Signal Design and Detection*, Prentice Hall, 1995.

T. Cover and J. Thomas, "*Elements of Information Theory*", Wiley Interscience, 1991

Course Description:

This is a second (but still introductory) course with the objective of becoming familiar with various topics and sub-systems of digital communication transceivers (modulators and demodulators mostly—*modems*): channels and system parameters, advanced modulation schemes (noncoherent, differentially coherent, multi-pulse schemes and performance), diversity concepts, equalization—channel estimation, information theory/capacity, coding, resource allocation.

Overview of topics:

- 1. Systems, diagrams, parameters, SNR, efficiency/utilization/ bandwidth**
 - Transmit-receive chains for single-carrier, spread-carrier, multi-carrier systems
 - Typical power budgets and SNR definitions
 - System utilization versus SNR
 - Mathematical description of base-band and band-pass signals and systems
 - Channel types
 - Bandwidth: definitions and computation for random digital streams

- 2. Information Theory and Coding**
 - Mutual Information, Entropy
 - Typical sequences, Shannon's theorem, capacity, fading channels
 - Dirty-paper coding

3. Diversity and multi-antenna systems

- Diversity concepts
- SIMO, MISO, MIMO channels
- Multiplexing versus diversity tradeoffs

5. Advanced modulation schemes

- noncoherent performance
- differentially coherent schemes
- OQPSK, MSK, CPM, GMSK (GSM)

6. Equalization/channel estimation

- Joint Likelihood Functionals, Joint Data and Channel Estimation
- Non-linear equalizers: DFE, MLSE

7. Multi-user aspects of communication links

- scheduling and system-level optimization