Digital Transmission Theory

Objectives of the course

This course introduces the mathematical foundations of modern digital transmission.

Expected skills

At the end of this class, the student should have acquired the following skills:

- Knowledge of the methodologies to represent noise in transmission systems
- Ability to solve simple loss, signal-to-noise ratio and power budget exercises
- Knowledge of the basic digital modulations
- Knowledge of linear distortion effect on digital modulations
- Ability to solve simple numerical and design exercised on transmission systems
- Introduction to information theory

The ability to apply the gained knowledge will be verified during the oral examination. The oral examination will also help students in improving their communication skills.

Prerequisites

- a good understanding of the mathematical topics that are typical covered in any Bachelor Engineering course during the first two years
- a good understanding of “Signal Theory” topics

Syllabus

Main topics covered in this class:

- Noise in electronic circuits (noise variance, spectrum, noise figure concepts)
- Analytic signal and complex envelope representation for bandpass signals
- Introduction to information theory: channel coding and AWGN channel capacity
- Baseband digital modulation (PAM), geometrical representation of signal, bit error probability
- Spectral properties of baseband digital modulation
- Inter-symbol Interference, Nyquist Theorem and introduction to adaptive equalization
- Passband modulation formats (PSK, QAM, FSK): bit error probability and spectral properties.

The theoretical lessons will be complemented by approximately 10 hours of practical exercises.

Laboratories and/or exercises

A part of the available hours will be devoted to the solution of numerical exercises and small projects related to all the main topics of the course. An actual laboratory activity is not planned.

Bibliography

The official textbook for this class is:

“Principles of Digital Transmission With Wireless Applications “


- The book is available in the POLITO library system at the following address:
  http://opac.biblio.polito.it/F/?func=direct&doc_number=000200305&local_base=PTOW
- It is also available as an electronic document:
- When possible, I will use the same notation of this book, and indicate during the lesson the book chapter I am using

The exercise material will be given step-by-step during the semester, and put on the web site

Exam

The exam will be a written exams, approximately 2 hours long, based on:

- 2-3 numerical exercises, similar to those that will be solved during the course.
- 2-3 theoretical questions, requiring a free-text answer.

The students that will get a score above 15/30 at the written exam can ask for an optional oral exam, where the questions will mostly regard the theoretical aspects of the course. The optional oral exam is always organized a few days after the written exams. It gives rise to -3 to +3 points that are added to the result of the written exam.