

Credits: 9

Code: ING-INF/03 Matter: Fundamentals of Telecommunications Main language of instruction: Italian Other language of instruction: English

Teaching Staff

<u>Head instructor</u> Prof. Danilo Orlando - danilo.orlando@unicusano.it

Introduction

1. Objective of the course :

The present course is aimed at providing the students with the necessary knowledge to deal with communication systems. Specifically, aspects related to the transmission of information in both digital and analog forms are suitably described highlighting the points of primary concern from an engineering point of view.

Objectives

2. Course Structure:

The course consists of 6 modules. The first module describes general aspects of a communication system, whereas the second module introduces analytical tools for signal representation. The third module is devoted to analog linear and nonlinear modulations, while the fourth module deals with information theory and general concepts of signal classification/detection. Finally, the fifth and sixth modules focus on baseband and passband digital transmission techniques, respectively.

Competencies:

At the end of the course, the student should be capable to

- perform link budget analysis in a telecommunication system;
- handle linearly and nonlinearly analog modulations;
- compute the capacity of a communication channel;
- deal with the transmission and reception of information in digital form.



<u>Syllabus</u>

3. Programme of the course:

1. Introduction.

Information transmission. Communication channels. Historical background. Communication schemes. Transmission Links. Radio Links (Link Budget) and Radar Equation. Thermal noise. Noise Figure. Amplifiers. System chains.

2. Signal Space.

Passband signals. Analytic signal and complex envelope. Hilbert Transform. Hilbert Filter. Phase and magnitude estimation. Bandpass systems. Bandpass random signals.

3. Analog Modulations.

Amplitude modulations: DSB-AM, DSB-SC-AM, SSB-AM, VSBAM. Multiplexing. Angle modulations: FM, PM. PLL. Superheterodyne receiver. Modulation noise.

4. Digital Communications.

Information Theory. Source coding. Channel capacity. Analog information sources. AWGN. Energy signal space. Detection Rules: MAP e ML. Multivariate channel. Analog channels. Matched Filter.

5. Baseband Digital Modulations.

PAM, PPM and Simplex: error probability and band efficiency. Lowpass LTI channel with limited band. ISI. Precoding.

6. Passband Digital Modulations.

ASK: receiver, error probability, energy. PSK: receiver, error probability, energy. QAM: receiver, error probability, energy. Synchronization and differential coding. Coherent and non coherent FSK: receiver, error probability, energy.

Evaluation system and criteria

The final evaluation consists in a written test formed by three engineering problems. Each problem accounts for 1/3 of the maximum grade, which is 30. The test is passed when the final grade is at least 18.



Bibliography and resources

4. Materials to consult:

- on-line lecture notes

- on-line recorded videos

5. Recommended bibliography:

J. G. Proakis, M. Salehi, "Communication Systems Engineering", Prentice-Hall, 1994.