FACULTY OF **ENGINEERING**

DEGREE COURSE: **COMPUTER AND CONTROL ENGINEERING BS**

**SUBJECT**: SIGNALS AND SYSTEMS

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## OBJECTIVES

This course is aimed at:

1) introducing the basic concepts of telecommunications, with focus on probability theory, Random Variables (RVs), and signals and systems (either time-continuous or time-discrete)
2) presenting the key principles of digital signal processing and numerical communications will be deepened.

## CONTENTS

- Ideas and axioms: probability in everyday life, sample spaces, sets, and events.
- Discrete sample spaces: uniform sample space and combinatorics.
- Conditional probability and applications: conditional probability, chain rule, total probability theorem, and Bayes formula.
- Continuous sample spaces and RVs: uniform and non-uniform sample spaces, continuous RVs and their Cumulative Distribution Function (CDF) and Probability Density Function (PDF), discrete RVs and their Probability Mass Function (PMF).
- Functions of RVs: calculation of CDF and PDF, expected value, and moments of a RV.
- Random vectors: conditional PDF/CDF, joint CDF/PDF, conditional expected value, linearity, correlation, and covariance.
- Signals: continuous-time and discrete-time signals, examples of signals, typical operations.
- Systems: definitions, Linear Time-Invariant (LTI) systems, difference equations.
- Sampling and quantization: the Nyquist theorem and characterization of the quantization noise.
- Frequency representation of signals and systems: the Fourier transform of continuous-time and discrete-time signals, the Discrete Fourier Transform (DFT), and the Fast Fourier Transform (FFT).
- Random processes: signals and random processes, stationary and ergodic processes.
- The Zeta transform: definition and practical computation, inversion, analysis of LTI systems and the transfer function.
- Digital communication systems: baseband and passband communications.

## LEARNING OUTCOMES

At the end of the course, students:

- will be familiar with the key aspects of the provided mathematical methods;
- be able to understand and analyze how a digital communication and signal processing system works
- derive insights on its performances.

## ASSESSMENT

Written exam: multiple choice and open questions

## RECOMMENDED TEXTBOOKS

- Papoulis and S. U. Pillai, *Probability, Random Variables and Stochastic Processes*, 4th Edition. New York, NY, USA: McGraw-Hill, 2002.
- V. Oppenheim and R. W. Schafer, *Discrete-Time Signal Processing*, 3rd Edition. Boston, MA, USA: Prentice Hall, 2010.