Probability Theory and Statistics EEE.4.4

This course aims at introducing students to the fundamental concepts of Probability Theory and Statistics, culminating multidimensional random variables and inferential statistics. The course also introduces basic ideas of modeling using Markov processes and techniques of proof that are of vital importance in future courses in electrical and electronics engineering.

On successful completion of this course students will be able to:

- calculate probabilities of stochastic events.
- understand the appropriate cognitive tools that are necessary for the development of statistical inference.
- solve problems that are modeled using random variables and draw conclusions on their results.
- understand the concept of the correlation and independence of random variables.
- comprehend the significance of the limit theorems in Probability Theory and the concept of convergence of random variables.
- model physical phenomena using Markov Chains and draw conclusions upon their analysis

The students are introduced into the basic ideas of inferential statistics, and learn methodologies with which they can generalize the conclusions they get for the sample to the population by using various estimators and interpreting their basic properties. They will also know, from the point of view of Statistics, the very important concepts of Linear Correlation and Linear Regression. The problems the students are dealt with in this course are related to the electrical and electronics engineering studies subject and to more general engineering applications and therefore the students will be equipped with all the required knowledge to cope with other courses.

Part 1 "Introduction to Probability Theory"

What is the usefulness of Probability Theory and Statistics. Basic Probability Theory Definitions. (Stochastic Models, Sample Space, Probability.) Stochastic Processes. Mutually exclusive events.
Enumeration Principles and elements of combination theory.
Probability Definitions. Probability properties.
Conditional Probability, Stochastic Independence Theorem of Total Probability.
Bayes Theorem.

Part 2 "Random Variables and Probability distributions"
Random variables and distribution functions. Discrete random variables. Continuous random variables. Definitions. Mean-Mode-Median.
Probability distributions for discrete random variables. Binomial distribution, Poisson distribution
Bernoulli distribution, Geometric distribution.
Probability distributions for continuous random variables. Uniform distribution, Exponential Distribution
Normal, Erlang, Gamma, and x^2 distributions.
Beta, Weibull and Rayleigh distributions.
Multidimensional random variables, 2-dimensional normal distribution.
Covariance, Correlation Factor, uncorrelated random variables.

Part 3 "Special Topics of Probability Theory"
Convergence of Random Variables, Limit Theorems, Central Limit Theorem.
Markov's Inequality, Chebyshev's inequality
Introduction of Markov Processes.
Applications and exercises in Markov chains.

Part 4 "Introduction to Descriptive and Inferential Statistics"
Introduction to Statistics Theory (Descriptive Statistics, Sampling, Sample Statistics, Histograms).
Introduction to Inferential Statistics, Parameters Estimation, Unbiased Estimators.
Confidence Intervals for the mean of Small and Large Samples.

Estimations of other parameters.

Part 5 "Linear regression."

Method of least squares, interpretation computing the coefficients.
Simple Linear Regression and its error.
Problems and exercises.