Subject:	Probability and Statistics	**Code**	93.24
Credits:	6	**Total hours:**	102
Department	of Exact and Natural Sciences	**Year:**	2020
Course:	Naval Engineering, Civil Engineering, Petroleum Engineering, Computer Science Engineering, Electrical Engineering, Bioengineering, Chemical Engineering, Mechanical Engineering, Electronic Engineering		

Curriculum: E 11A, M22, C23, S10 A - Rev18, N22, Bio-13, S10 - Rev18, BIO 22, E 11, K22, K07A-Rev.18, P22, S10-Rev23, Q22, K07-Rev.18

Subject presentation:

Uncertainty has a fundamental character in the exact and natural sciences. In this subject, the fundamentals of probability, which is the mathematical field focused on the work of quantifying uncertainty, are seen. To mention just a few aspects where it is found in areas linked to the specific field of the students of this course: interpretation of quantum mechanics (seen in Physics IV, 93.44); statistical physics applied to semiconductors (seen, e.g., in Electronics I 22.59).

In the subject Probability and Statistics (93.24), students are also introduced to stochastic processes, which are applied in many branches of engineering. The students of the Electronic Engineering course will deepen this knowledge in Random Signals (22.67). Stochastic processes are fundamental in the area of communications, and therefore the introduction in 93.24 will be useful, for example, for Computer Science Engineering students to understand the principles of information and communication theory in Communication Protocols (72.07), and for Electronic Engineering students to deal with the elements of information theory and coding seen in Information Transmission (22.61). The various manifestations of what is commonly referred to as noise can only be appropriately described as stochastic processes. Bioengineering students study forms of noise cancellation, for example, in the Biomedical Signal Processing course (16.15).

In this subject, students are introduced to simulation problems that require the use of pseudo-random numbers through practical exercises called Computer Aided Exercises (CAEs). This type of simulation is very common in the various engineering fields. Students of Computer Science Engineering, for example, will see probabilistic models in the subject Systems Simulation (72.25).

The Probability and Statistics course is complemented by an introduction to three other topics of importance in all areas of engineering and management. One of them is descriptive statistics, which allows the sum and ordered visualization of large amounts of data. The second topic is estimation, which allows values to be given to probabilities from observations. And the third topic is hypothesis testing, a fundamental tool in decision making.

Learning objectives:

At the end of this course the student is expected to be able to

a) Value the importance of the stochastic approach in the analysis of certain problems.

b) Organize data in tables and graphs in a manner conducive to the interpretation of information from a random sample.

c) Analyze and model random phenomena with the introduction of random variables and their probability distribution.

d) To formulate and specify hypothesis tests on populations based on sample information.

Contents:

No.	Description
1	**Concept of probability** Random phenomena. Descriptive statistics. The classical definition of probability. Mathematical model for random experiments. Sample space. Axiomatic definition of probability. Conditional probability. Independent events. Bayes' theorem.

No.	Description
2	**Random variable** General notion of random variable. Discrete and continuous random variables. Expected value of a random variable. Measures of central tendency and dispersion. Binomial variables and Poisson variables. Continuous random variables: uniform, exponential and normal.
3	**Joint analysis of random variables.** Joint distributions of probabilities and marginals. Independent random variables. Covariance.
4	**Stochastic processes.** Counting processes. Poisson processes: deduction, examples and applications. Markov chains: asymptotic study and applications.
5	**Sums of random variables.** Introduction. The law of large numbers. Normal approximation to the binomial. The central limit theorem. (without demonstration). Chebyshev's Inequality.
6	**Samples and sampling distributions** Introduction. Random samples. Concept of estimator. Properties. Distribution of mean and sample variance. Student's t-distribution. Point and interval estimation. Confidence intervals: different cases.
7	**Statistical hypothesis testing.** Basic concepts. Types of critical regions. Uni- and bilateral tests. Hypothesis testing, different cases concerning means, variances and proportions.

Laboratory assignments:

No.	Description
1	**No laboratory assignments.** No subject.

Required bibliography:

No.	Description
1	Devore, J. (2016). Probability and Statistics for Engineering and Science 9th. Ed. México D.F., Mexico : Cengage Learning Editores

Additional bibliography:

No.	Description
1	Bertsekas, D., Tsitsiklis, J. (2008). Introduction to probability, 2nd ed. E.U.A.: Athena Scientific.
2	Papoulis A. (1990). Probability and statistics Englewood Cliffs, NJ, E.U.A.: Prentice Hall.
3	Meyer, P.(1992).Probability and statistical applications. E.U.A.: Addison Wesley.
4	Mendenhall, W., Sincich, T. (1997). Probability and statistics for engineering and science. México: Prentice Hall.
5	Allen,A.O.(1990). Probability, Statistics and Queueing Theory With Computer Science Applications. E.U.A.: Academic Press Inc.

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