COURSE DESCRIPTION CARD - SYLLABUS

Course name
Probabilistic methods in electronics and telecommunications

Course

Field of study
Electronics and Telecommunications
Area of study (specialization)

Level of study
First-cycle studies
Form of study
full-time

Year/Semester
II/III
Profile of study
general academic
Course offered in
english
Requirements
compulsory

Number of hours

Lecture
30
Tutorials
15

Laboratory classes

Projects/seminars
-/-

Other (e.g. online)

Number of credit points

3

Lecturers

Responsible for the course/lecturer:
prof. dr hab. inż. Maciej Stasiak,
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Responsible for the course/lecturer:
dr Joanna Weissenberg,
joanna.weissenberg@put.poznan.pl

Prerequisites

The student should have a basic knowledge of mathematics with basic set theory, combinatorics and mathematical analysis. Be able to extract information from English language literature, databases and other sources and he is committed to further self-study.

Course objective

The aim of the course is to familiarise students with the basics of probability and probabilistic methods used in engineering practice of electronics and telecommunications.

Course-related learning outcomes

Knowledge

Has a systematic knowledge of theory of probability.

Skills

1. Is able to use theory of probability concepts to solve basic problems in electronics and telecommunication.

2. Is capable of studying autonomously.

Social competences

1. Is aware of the limitations of his/her current knowledge and skills.

2. Is committed to further self-study.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Knowledge acquired during the tutorials is verified on the basis of a test. Students solve 5-6 tasks, scored differently depending on the level of difficulty of the problems. Passing threshold: 50% of points. Depending on the results, the scoring may change.

Knowledge acquired during lecture is verified on the basis of a test. The test includes 25-30 equally scored questions. Each question has 4 answers, one of which is true. Passing threshold: 50% of points (correct answers). Depending on the results, the scoring may change. In the case of a small number of students, the credit may be given on the basis of a direct conversation with the lecturer.

Programme content

1. Historical overview; data reduction: graphical presentation of data; numerical characteristics of sets of data.

2. Algebra of sets and combinatorial analysis: fundamentals of set theory; elements of combinatorics; permutations, variations, combinations.

3. Basic notions and rules of probability theory: random events, probability definitions; algebra of events and probabilities; conditional probability; low of total probability; Bayes' theorem; independence of events.

4. Properties and characteristics of one-dimensional random variables: cumulative distribution function and its properties; probability density function and its properties; moments and central moments of random variable; expected value; variance and standard deviation; coefficient of skewness; coefficient of excess.

5. Distributions of random variables; discrete random variables: Dirac distribution, two point distribution, Bernoulli distribution, Poisson distribution, geometric distribution, hypergeometric distribution, Pascal distribution; continuous random variables: rectangular distribution, exponential distribution, Poisson distribution; normal distribution; gamma distribution.

6. Characteristic functions: properties of characteristic functions; generation of moments; properties of moment-generating functions; properties of probability generating functions; characteristic and moment-generating functions of basic probability distributions.

7. Properties and characteristics of two-dimensional random variables: cumulative distribution function and probability density function of two dimensional random variable; marginal distributions; conditional distributions; independence of random variables; raw and central moments, covariance and correlation coefficient; characteristics of conditional distributions; regression of type I; regression of type II; least-squares method; two-dimensional normal distribution.

8. Laws of large numbers and limit theorems: Markov inequality; Chebyshev inequality; "three sigma" rule; law of large numbers: Bernoulli law of large numbers; Chebyshev law of large numbers; integral and local limit theorems: Lindeberg-Levy central limit theorem, Moivre-Laplace integral limit theorem, Poisson local limit theorem, Moivre-Laplace local limit theorem.

9. Basic notions and elements of statistics: empirical cumulative distribution function; empirical moments; distribution series; empirical moments; chosen distributions used in statistics: standard normal distribution, Chi-square distribution, Student distribution; estimators; properties of estimators; confidence intervals; basic concepts of hypothesis testing.

10. Introduction to stochastic processes: Poisson process; Markov process; Kolmogorov equations; steady states; state equations.

11. Application of elements of probability in teleinformatics issues: Fundamentals of analytical modeling of network systems; birth and death process; Erlang model for full availability resources; Fundamentals of simulation modeling of network systems; embedded Markov chain and Monte Carlo method.

Teaching methods

1. Lecture: multimedia presentation illustrated with examples.

2. Tutorials: multimedia presentation illustrated with examples; solving problems given by the teacher.

Bibliography

Basic

1. Soong T.T., Fundamentals of Probability and Statistics for Engineers, John Wiley and Sons, Ltd, 2004. (available free on the net)

2. Walpole R.E., Myers R. H., Myers S. L.,Ye K., Probability & statistics for engineers & scientists, Pearson, 2017.

3. Ross S., A First Course in Probability, Prentice Hall, New Jersey, 2010 (available free on the net)

Additional

1. Teaching materials for lectures available to students in the form of pdf files.

2. J. Walrand, Lecture Notes on Probability Theory and Random Processes, Departament of Electrical Engineering and Computer Sciences, University of California, Berkeley, 2004.

3. A. Papoulis, Probability, Random Variables and Stochastic Processes, McGraw-Hill, Inc., 1991.

Breakdown of average student's workload

	Hours	ECTS
Total workload	90	3,0
Classes requiring direct contact with the teacher	55	2,0
Student's own work (literature studies, solving homework tasks, preparation for tutorials and laboratory classes, preparation for tests and the exam) [1]	35	1,0

[1] delete or add other activities as appropriate