COURSE DESCRIPTION CARD - SYLLABUS

Course name
Probabilistic methods in ICT [S1MiKC1E>PiSwICT]

Course

Field of study
Microelectronics and Digital Communication

Year/Semester
1/1

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
English

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
30

Laboratory classes
0

Other
0

Tutorials
30

Projects/seminars
0

Number of credit points

5,00

Coordinators

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Lecturers

Prerequisites

The student should have a basic knowledge of mathematics with basic set theory, combinatorics and mathematical analysis. He should also have the ability to think logically and understand the necessity of expanding knowledge and be open to understand the problems of the surrounding reality.

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:
s able to extract information from English or Polish language literature, databases and other sources.
Is able to integrate and interpret the obtained information, draw conclusions and justify opinions.
Is able to use theory of probability concepts to solve basic problems in ICT.

Social competences:
Is aware of the limitations of his/her current knowledge and skills.
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

The program covers issues in the field of probability theory and statistics: basics of data analysis, basic notions and rules of probability theory, characteristics of one-dimensional random variables, the most important discrete and continuous distributions, characteristic functions and generating functions, characteristics of two-dimensional random variables, regression, laws of large numbers and limit theorems, basic notions and elements of statistics, examples of distributions used in statistics, elements of statistical estimation and inference, confidence intervals, introduction to stochastic processes, fundamentals of modeling of network systems.

Course topics

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, 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.
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 electronic and telecommunications issues: Fundamentals of analytical modelling of network systems; birth and death process; Erlang model for full availability resources; Fundamentals of simulation modelling 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. Bobrowski D., Łybacka K., Wybrane metody wnioskowania statystycznego, Wydawnictwo Politechniki Poznańskiej, Poznań, wydania 1988, 1995, 2001, 2002, 2004, 2006.
2. Plucińska A., Pluciński E., Probabilistyka: procesy stochastyczne, statystyka matematyczna, rachunek prawdopodobieństwa, WNT, Warszawa, wydania 2000, 2005, 2006, 2015, 2017.
3. Krysicki W., Bartos J., Dyczka W., Królikowska K., Wasilewski M., Rachunek prawdopodobieństwa i statystyka matematyczna w zadaniach, część I i II, PWN,Warszawa, wydania 1998, 2000, 2002, 2007.

Additional:
1. Teaching materials for lectures, available to students in the form of pdf files.
2. Feller W., Wstęp do rachunku prawdopodobieństwa, PWN, Warszawa, 2006.
3. Benjamin J.R., Cornell C.A., Rachunek prawdopodobieństwa, statystyka matematyczna i teoria decyzji dla inżynierów, WNT, Warszawa, (dowolne wydanie)
4. Bobrowski D., Probabilistyka w zastosowaniach technicznych, WNT, Warszawa, 1986. 5. Stasiak M, Głąbowski M., Hanczewski S., Zwierzykowski P.: Podstawy inżynierii ruchu i wymiarowania sieci teleinformatycznych, Wydawnictwo Politechniki Poznańskiej, Poznań, 2009.

Breakdown of average student's workload

	Hours	ECTS
Total workload	135	5,00
Classes requiring direct contact with the teacher	60	2,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	75	3,00