# 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
1/1

Profile of study
general academic

Course offered in
polish

Requirements
Compulsory

## Number of hours

Lecture
30

Tutorials
15

Laboratory classes

Projects/seminars

Other (e.g. online)

## Number of credit points

4

## Lecturers

Responsible for the course/lecturer:
prof. dr hab. inż. Maciej Stasiak,
maciej.stasiak@put.poznan.pl

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. 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

Is 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 electronics and telecommunication.

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

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 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. 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 | 100 | 4,0 |
| Classes requiring direct contact with the teacher | 55 | 2,0 |
| Student's own work (literature studies, preparation for ctutorials, preparation for tests/exam, project preparation) | 45 | 2,0 |