# COURSE DESCRIPTION CARD - SYLLABUS

Course name
Theory of probability

## Course

Field of study
Mathematics in Technology

Year/Semester
2/3

Area of study (specialization)

Profile of study
general academic

Level of study
First-cycle studies

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

## Number of hours

Lecture
30

Laboratory classes

Other (e.g. online)

Tutorials
30

Projects/seminars

## Number of credit points

3

## Lecturers

Responsible for the course/lecturer:
dr inż. Barbara Popowska
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Faculty of Automatic Control, Robotics and Electrical Engineering
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Responsible for the course/lecturer:

## Prerequisites

A student has knowledge of terminology used in the following courses: Mathematical Analysis I and Mathematical Analysis II. The student is able to use knowledge on: the calculus of sentences and quantifiers, the set theory, and the differential and integral calculus. The student is aware of the level of their knowledge and the need of deepening and expansion of their knowledge.

## Course objective

The main aim of this course is to familiarize the student with: the basic concepts of the probability theory, the methods of determining the probability of random events, examples of random variables, the methods of determining the parameters of random variables, and the possibilities of using selected distributions of random variables to describe random phenomena.

## Course-related learning outcomes

Knowledge

1. Student knows the basic concepts and theorems of the probability theory, and examples of discrete and continuous random variables.

2. Student has knowledge of the probability theory concerning the possibility of applying selected distributions of random variables to the modeling of relevant random phenomena.

Skills

Student applies appropriate theorems to determine the probability of random events; is able to list examples of random variables; determines the parameters of random variables of discrete and continuous type; applies appropriate types of random variable distributions to the analysis of random phenomena.

Social competences

1. Student understands and appreciates the importance of intellectual honesty in own and other people's activities; is ready to demonstrate reliability, impartiality, professionalism and ethical attitude.

2. Student is aware of their social role as a graduate of a technical university, is ready to pass on popular science content to the public and to identify and resolve basic problems related to the field of study.

## Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture:
Knowledge acquired during the lecture is verified on the basis of a written test. To pass the lecture it is necessary to get at least 50% of the points from the mentioned written test.

Tutorials:
Skills acquired during the classes are verified on the basis of two colloquia. To pass the classes it is necessary to get at least 50% of the total number of points from the mentione colloquia.

Grading system:
- 0%-50% - 2.0,
- 50%-60% - 3.0,
- 60%-70% - 3.5,
- 70%-80% - 4.0,
- 80%-90% - 4.5,
- 90%-100% - 5.0.

## Programme content

Lecture:
1. Elements of combinatorics (a permutation, a variation with repetition, a variation without repetition, a combination).
2. Random events and probability (a space of elementary events, classical definition of a probability,

general definition of a probability, a probability space, a random event, the probability properties, a geometrical probability, a conditional probability, the law of total probability, the Bayes rule, an independence of random events).
3. Random variables and their distributions (definition of a random variable, the properties of random variables, a distribution of a random variable, a cumulative distribution function of a random variable and its properties, the review of selected discrete type distributions (a distribution of a random variable that takes exactly one value almost surely, a distribution of a random variable that takes a value A with the probability p and a value B with the probability 1-p, a binomial distribution, a Poisson distribution, a geometric distribution, a negative binomial distribution, a hypergeometric distribution), a density function of a random variable, the review of selected continuous type distributions (a continuous uniform distribution, an exponential distribution, a normal distribution (Gaussian distribution), a gamma distribution, a beta distribution, a Cauchy distribution, t-Student distribution, Chi-Squere distribution, F-Snedecor distribution), independent random variables and their properties).
4. Two-dimensional random variables (definition of a random vector, a joint probability distribution of a random vector, a cumulative distribution function of a random vector, a random vector of discrete type, a marginal distribution, a random vector of continuous type, a marginal density function, a convolution of probability distributions).
5. Expected value and moments of a random variable (definition and properties of an expected value of a random variable, moments of a random variable, quantiles of a random variable, a variance of a random variable, properties of the variance, the parameters of selected types of random variables distributions, a covariance of random variables, properties of the covariance, a correlation coefficient and its properties).
6. Limit theorems (the law of large numbers, the central limit theorem).
7. Characteristic function of a random variable (definition of a characteristic function and its properties).
Tutorials:
1. Elements of combinatorics (the total number of possibilities of a random phenomena).
2. Random events and probability (finding of probabilities of random events, investigation the independence of random events).
3. Random variables and their distributions (determination of distributions of random variables, investigation and finding the cumulative distribution function and the density function for random variables, application of selected types of random variable distributions to finding the probability of random real-world phenomena).
4. Expected value, moments and variance of a random variable, and covariance and correlation coefficient of random variables (finding of parameters for random variables and random vectors).
5. Limit theorems (application the central limit theorem to determine the probability of random real-world phenomena).
6. Characteristic function of a random variable (finding of characteristic functions of random variables).

## Teaching methods

Lecture: traditional lecture with a presentation and tasks counted on the blackboard (theory presented in connection with the current knowledge of students).

Tutorials: blackboard tutorials (solving of math problems with the help of a teacher).

## Bibliography

Basic

1. A. Plucińska, E. Pluciński, Probabilistyka: statystyka matematyczna, procesy stochastyczne, rachunek prawdopodobieństwa, Warszawa, Wydawnictwo Naukowe PWN SA, 2017.

2. W. Krysicki, J. Bartos, W. Dyczka, K. Królikowska, M. Wasilewski, Rachunek prawdopodobieństwa i statystyka matematyczna w zadaniach część 1: Rachunek prawdopodobieństwa, Warszawa, Wydawnictwo Naukowe PWN, 2012.

3. M. Krzyśko, Wykłady z teorii prawdopodobieństwa, Warszawa, Wydawnictwa Naukowo-Techniczne, 2000.

Additional

1. W. Kordecki, Rachunek prawdopodobieństwa i statystyka matematyczna: definicje, twierdzenia, wzory, Wrocław, Oficyna Wydawnicza GiS, 2010.

2. W. Feller, Wstęp do rachunku prawdopodobieństwa część 1, Warszawa, Państwowe Wydawnictwo Naukowe, 2006.

3. H. Jasiulewicz, W. Kordecki, Rachunek prawdopodobieństwa i statystyka matematyczna: przykłady i zadania, Wrocław, Oficyna Wydawnicza GiS, 2003.

## Breakdown of average student's workload

| | Hours | ECTS |
|---|---|---|
| Total workload | 90 | 3,0 |
| Classes requiring direct contact with the teacher | 60 | 2,0 |
| Student's own work (literature studies, preparation for tutorials, preparation for colloquia, preparation for the written test) [1] | 30 | 1,0 |

[1] delete or add other activities as appropriate