



## Subject card

|   |   |   |                                     |  |  |         |     |
|---|---|---|-------------------------------------|--|--|---------|-----|
| Subject name and code                       | Safety and risk analysis in technology , PG_00025522  |   |                                     |  |  |         |     |
| Field of study                              | Mathematics   |   |                                     |  |  |         |     |
| Date of commencement of studies             | October 2023  | Academic year of realisation of subject   |                                     |  | 2025/2026  |         |     |
| Education level                             | first-cycle studies   | Subject group   |                                     |  | Optional subject group<br>Subject group related to scientific research in the field of study |         |     |
| Mode of study                               | Full-time studies   | Mode of delivery  |                                     |  | at the university  |         |     |
| Year of study                               | 3   | Language of instruction   |                                     |  | Polish   |         |     |
| Semester of study                           | 5   | ECTS credits  |                                     |  | 5.0  |         |     |
| Learning profile                            | general academic profile  | Assessment form   |                                     |  | exam   |         |     |
| Conducting unit                             | Department of Probability Theory and Biomathematics -> Faculty of Applied Physics and Mathematics   |   |                                     |  |  |         |     |
| Name and surname of lecturer (lecturers)    | Subject supervisor  | dr inż. Magda Dettlaff  |                                     |  |  |         |     |
|   | Teachers  |   |                                     |  |  |         |     |
| Lesson types and methods of instruction     | Lesson type   | Lecture   | Tutorial                            | Laboratory   | Project  | Seminar | SUM |
|   | Number of study hours   | 30.0  | 15.0                                | 0.0  | 15.0   | 0.0     | 60  |
|   | E-learning hours included: 0.0  |   |                                     |  |  |         |     |
|   | Adresy na platformie eNauczanie:  |   |                                     |  |  |         |     |
| Learning activity and number of study hours | Learning activity   | Participation in didactic classes included in study plan  | Participation in consultation hours |  | Self-study   |         | SUM |
|   | Number of study hours   | 60  | 5.0                                 |  | 60.0   |         | 125 |
| Subject objectives                          | Introduction to basic mathematical problems related to risk and safety of the human activity, especially in technology. Developing and improving competences in building mathematical models of real objects, with application of probability and statistics.   |   |                                     |  |  |         |     |
| Learning outcomes                           | Course outcome  | Subject outcome   |                                     |  | Method of verification   |         |     |
|   | K6_W03  | The student is able to analyze the given model. Performs statistical tests, analyzes the results.       |                                     |  | [SW1] Assessment of factual knowledge  |         |     |
|   | K6_U12  | The student carries out a project in the R environment, in which he analyzes the risk of a given model. |                                     |  | [SU2] Assessment of ability to analyse information   |         |     |
|   | K6_K04  | The student draws conclusions at each stage of the project based on the results of statistical tests.   |                                     |  | [SK2] Assessment of progress of work   |         |     |
|   | K6_U05  | The student understands mathematical theorems and uses them to solve problems.                          |                                     |  | [SU4] Assessment of ability to use methods and tools   |         |     |
| K6_K02                                      | The student appreciates the importance of self-expanding knowledge. Performs exercises to consolidate knowledge by himself.   |   |                                     | [SK5] Assessment of ability to solve problems that arise in practice |  |         |     |
| Subject contents                            | Risk in historical perspective, basic notions and context. Risk management and business ethic (human factor). Elements of reliability theory. Modeling of random phenomenon. Revision of selected notions of probability and mathematical statistics. Laplacea transform. Characteristics of reliability, hazard function. Systems without replacement. Extremal statistics. Classical and dual risk processes. Mathematical risk measures. |   |                                     |  |  |         |     |
| Prerequisites and co-requisites             | Courses completed: Probability Theory term IV (MAT1013/1)   |   |                                     |  |  |         |     |
| Assessment methods and criteria             | Subject passing criteria  | Passing threshold   |                                     |  | Percentage of the final grade  |         |     |
|   | Projects  | 33.0%   |                                     |  | 40.0%  |         |     |
|   | Test  | 33.0%   |                                     |  | 30.0%  |         |     |
|   | exam  | 33.0%   |                                     |  | 30.0%  |         |     |

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|--|---|---|
| Recommended reading  | Basic literature  | <p>C.Klüppelberg, D.Straub, ... , Risk, Springer, 2014.</p> <p>T.Aven, U.Jensen, Stochastic Models in Reliability, Springer (1999), 2014.</p> <p>B.Kopociński, Zarys teorii odnowy i niezawodności, PWN, 1973.</p> <p>D.C.M.Dickson, Insurance Risk and Ruin, CUP, 2006.</p>                          |
|  | Supplementary literature  | <p>F.Jacob, Risk Estimation on High Frequency Financial Data, Springer, 2015.</p> <p>H.Mohanty, P.Bhuyan, D.Chenthati, Big Data, Springer, 2015.</p> <p>R.Wieczorkowski, R.Zieliński, Komputerowe generatory liczb losowych, WNT, 1997.</p> <p>M.Gagolewski, Programowanie w języku R, PWN, 2014.</p> |
|  | eResources addresses  |   |
| Example issues/<br>example questions/<br>tasks being completed | <p>On exercises students solve problems which are provided by the lecturer, while others give their comments and suggest improvements. Test/exam problems are based on mentioned lists and topics from lectures. To pass the subject a student has to work out two research projects and submit them on a fixed date.</p> <p>Find a hazard function. Evaluate mean residual time. Minimalize risk in proper maintenance machine parks.</p> <p>A component has TTF density given by <math>f(t)=kt^4e^{-5t}</math>, <math>t&gt;0</math>. Find: a) <math>k</math>, b) <math>R(t)</math>, c) <math>h(t)</math>, d) MTTF.</p> <p>Consider a process where the components are replaced at a set time <math>t_r</math>, or replaced at failure if it occurs before <math>t_r</math>. What is the mean life of a component of this type, in terms of the reliability?</p> |   |
| Work placement   | Not applicable  |   |