



## Subject card

|   |  |  |   |                                     |                               |            |     |
|---|--|--|---|-------------------------------------|-------------------------------|------------|-----|
| Subject name and code                       | Stochastic integral, PG_00021509   |  |   |                                     |                               |            |     |
| Field of study                              | Mathematics  |  |   |                                     |                               |            |     |
| Date of commencement of studies             | October 2024   |  | Academic year of realisation of subject   |                                     | 2024/2025                     |            |     |
| Education level                             | second-cycle studies   |  | Subject group   |                                     |                               |            |     |
| Mode of study                               | Full-time studies  |  | Mode of delivery  |                                     | at the university             |            |     |
| Year of study                               | 1  |  | Language of instruction   |                                     | Polish                        |            |     |
| Semester of study                           | 2  |  | ECTS credits  |                                     | 5.0                           |            |     |
| Learning profile                            | general academic profile   |  | Assessment form   |                                     | exam                          |            |     |
| Conducting unit                             | Department of Nonlinear Analysis and Statistics -> Faculty of Applied Physics and Mathematics  |  |   |                                     |                               |            |     |
| Name and surname of lecturer (lecturers)    | Subject supervisor   |  | prof. dr hab. inż. Tomasz Szarek  |                                     |                               |            |     |
|   | Teachers   |  | prof. dr hab. inż. Tomasz Szarek<br><br>Gabriela Łuczyńska  |                                     |                               |            |     |
| Lesson types and methods of instruction     | Lesson type  | Lecture  | Tutorial  | Laboratory                          | Project                       | Seminar    | SUM |
|   | Number of study hours  | 30.0   | 30.0  | 0.0                                 | 0.0                           | 0.0        | 60  |
|   | E-learning hours included: 0.0   |  |   |                                     |                               |            |     |
| 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                          | Main aim is to equip the student is advanced mathematical tools in technical subjects.   |  |   |                                     |                               |            |     |
| Learning outcomes                           | Course outcome   |  | Subject outcome   |                                     | Method of verification        |            |     |
| Subject contents                            | Probability spaces with filtraation. Stochastic basis. Stopping times and their basic properties. Classyfication of stoping times. Optional i prognose sigam-algebras. Increasin processes, processes with finite variation and processes with integrable variation. Localization. martingales with continuous time. and their basic properties. The Doob-Meyer decomposition. Square integrable martingales. Stochastic integral with respect to local martingales with continuous paths.and their basic properties. Ito's formula and it applications.. The Girsanov theorem. The decomposition of lokal martingales. Stochastic integral with respect to local martingales and semimartingales. |  |   |                                     |                               |            |     |
| Prerequisites and co-requisites             | Probability theory, measure theory and functional analysis.  |  |   |                                     |                               |            |     |
| Assessment methods and criteria             | Subject passing criteria   |  | Passing threshold   |                                     | Percentage of the final grade |            |     |
|   | Colloquium 1   |  | 51.0%   |                                     | 20.0%                         |            |     |
|   | Exam   |  | 51.0%   |                                     | 60.0%                         |            |     |
|   | Colloquium 2   |  | 51.0%   |                                     | 20.0%                         |            |     |
| Recommended reading                         | Basic literature   |  | 1) R. Elliot: Stochastic calculus and applications, Springer 1982.<br><br>2) H. Kuo, Introduction to stochastic integration, Springer 2006. |                                     |                               |            |     |

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|  | Supplementary literature  | <p>1) C. Dillecherie, P..A. Meyer, Probabilities and potential, tom 2., North-Holland 1982..</p> <p>2) P. Protter, Stochastic Integration and differential equations, Springer 1990.</p> <p>3) O. Kallenberg, Foundations of modern probability, Springer 2001.</p> <p>4) Sheng-wu He, Jia-gang Wang, Jia-an Yan, Semimartingale theory and stochastic calculus, Science Press, New York 1992.</p> |
|  | eResources addresses  | <p>Podstawowe</p> <p><a href="https://enauczanie.pg.edu.pl/moodle/course/view.php?id=31019">https://enauczanie.pg.edu.pl/moodle/course/view.php?id=31019</a> - Adresy na platformie eNauczanie:</p>  |
| Example issues/<br>example questions/<br>tasks being completed | <p>Discuss the construction of stochastic integrals with respect to local martingales with continuous paths.</p> <p>Give the general stopping theorem.</p> <p>Give the Ito formula and proved it.</p> |  |
| Work placement   | Not applicable  |  |

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