GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

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| Subject name and code | Stochastic integral, PG_00021509 | | |
| Field of study | Mathematics | | |
| Date of commencement of studies | October 2023 | Academic year of realisation of subject | 2023/2024 |
| Education level | second-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 | blended-learning |
| 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>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: 30.0 | | | | | | |

| 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 |

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| 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 |
|---|---|---|
| [K7_U06] Has the ability to recognize topological structures in mathematical objects occurring, for example, in geometry or mathematical analysis; is able to use the basic topological properties of sets, functions and transformations, uses the language and methods of functional analysis in the problems of mathematical analysis and its applications, in particular uses the properties of classical Banach and Hilbert spaces. | Student can proved the existence of thestochastic integral and can count it applying basic theorems of stochstic integrations | [SU4] Assessment of ability to use methods and tools |
| [K7_U10] In a selected field, can examine evidence, in which, if necessary, also can use tools from other branches of mathematics, can identify one's own interests and develop them; in particular, is able to establish contact with specialists in their field, e.g. understand their lectures intended for young mathematicians. | Student can proved the existence of thestochastic integral and can count it applying basic theorems of stochstic integrations | [SU4] Assessment of ability to use methods and tools |
| [K7_W02] Has good understanding of the role and importance of mathematical reasoning structure. | Students knows the constructions of stochastic integrals and can recognize the difference among them. | [SW1] Assessment of factual knowledge |
| [K7_W04] Has enhanced knowledge of a selected branch of mathematics, theoretical or applied. | Student knows advanced theorems of stochastic integral | [SW1] Assessment of factual knowledge |

**Subject contents**

Probability spaces with filtraation. Stochastic basis. Stoping times and their basic properties. Classyfication of stoping times. Optional i prognose sigam-algebras. Increasin processes, processes with finite wariation and processes with integrable wariation. 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 2 | 51.0% | 20.0% |
| Exam | 51.0% | 60.0% |
| Colloquium 1 | 51.0% | 20.0% |

**Recommended reading**

Basic literature

1) R. Elliot: Stochastic calculus and applications, Springer 1982.

2) H. Kuo, Introduction to stochastic integration, Springer 2006.

Supplementary literature

1) C. Dllecherie, P..A. Meyer, Probabilities and potential, tom 2., North-Holland 1982..

2) P. Protter, Stochastic Integration and differential equations, Springer 1990.

3) O. Kallenberg, Foundations of modermn probability, Springer 2001.

4) Sheng-wu He, Jia-gang Wang, Jia-an Yan, Semimartingale theorey and stochastic

calculus, Science Press, New York 1992.

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| | eResources addresses | Podstawowe<br>https://enauczanie.pg.edu.pl/moodle/course/view.php?id=31019 -<br>Adresy na platformie eNauczanie:<br>Całka stochastyczna 23/24 - Moodle ID: 37728<br>https://enauczanie.pg.edu.pl/moodle/course/view.php?id=37728 |
| Example issues/ example questions/ tasks being completed | Discuss the construction of stochastic integrals with respect to local martingales with continuous paths.<br><br>Give the general stopping theorem.<br><br>Give the Ito formula and proved it. | |
| Work placement | Not applicable | |