GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	, PG_00066753		
Field of study	Mathematics		
Date of commencement of studies	October 2023	Academic year of realisation of subject	2024/2025
Education level	second-cycle studies	Subject group	Specialty subject group 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	2	Language of instruction	Polish
Semester of study	4	ECTS credits	3.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Institute of Applied Mathematics -> Faculty of Applied Physics and Mathematics		
Name and surname of lecturer (lecturers)	Subject supervisor	dr Klaudiusz Czudek	
	Teachers	dr Klaudiusz Czudek	

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	30.0	0.0	0.0	0.0	30.0	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	10.0	75

Subject objectives

The goal is to get the students acquainted with the basic notions of ergodic theory and its connections to the selected processes from financial mathematics.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_W05] Has enhanced knowledge of a selected branch of mathematics: knows most classical definitions and theorems and their proofs, Understands problems being examined, Knows relations between problems from particular field with other branches of mathematics, theoretical and applied	The student knows the Birkhoff ergodic theorem and basic examples of its application. The student is able to describe the ergodic properties of the Wiener process.	[SW1] Assessment of factual knowledge
[K7_U13] Understands the mathematical foundations of the analysis of algorithms and computational processes, can construct algorithms with good numerical properties, used to solve typical and unusual mathematical problems.	Student can verify the validity of the central limit theorem for dynamical systems.	[SU3] Assessment of ability to use knowledge gained from the subject
[K7_W08] Knows advanced computation techniques, supporting the work of a mathematician and understand their limitations.	The student is able to use a computer (e.g. Python) to come up with conjectures involving given dynamical system.	[SW1] Assessment of factual knowledge

<table>
<tr><td>Subject contents</td><td>1. Definition of a measure preserving dynamical system, ergodic system, weak and strong mixing, multiple mixing. Rokhlin problem.

2. Birkhoff ergodic theorem.

3. Metric entropy and its basic properties. Examples of calculation of metric entropy.

4. Topological entropy and its basic properties. Examples of calculation of topological entropy.

5. Variational principle.

6. Spectral theory, characterization of mixing in terms of spectral theory.

7. Limit theorems for torus automorphisms.</td></tr>
<tr><td>Prerequisites and co-requisites</td><td>Probability, measure theory</td></tr>
<tr><td>Assessment methods and criteria</td><td><table><tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr><tr><td>Exam</td><td>50.0%</td><td>100.0%</td></tr></table></td></tr>
<tr><td>Recommended reading</td><td><table><tr><td>Basic literature</td><td>Katok A., Hasselblatt B. Introduction to the Modern Theory of Dynamical Systems, Cambridge University Press 1995

Walters P. An Introduction to Ergodic Theory, Springer 1982

Fomin S.W., Kornfeld I. P, Sinaj J. G. Teoria ergodyczna, PWN 1987

Petersen K. Ergodic theory, Cambrigde University Press 1983

Dolgopyat D. Limit theorem for hyperbolic systems</td></tr><tr><td>Supplementary literature</td><td>W. Rudin, Analiza funkcjonalna, Wydawnictwo PWN

Kallenberg, Foundations of modern probability, Springer 2002</td></tr><tr><td>eResources addresses</td><td>Adresy na platformie eNauczanie:
Teoria ergodyczna 2024/2025 - Moodle ID: 45464
https://enauczanie.pg.edu.pl/moodle/course/view.php?id=45464</td></tr></table></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td>1. Give the statement and proof of the Birkhoff ergodic theorem.

2. Give the definition of metric entropy. Calculate the metric entropy of a given dynamical system.

3. Show that a given measure is invatriant for a given dynamical system.

4. Give the proof of the central limit theorem for toral automorphisms.</td></tr>
<tr><td>Work placement</td><td>Not applicable</td></tr>
</table>

Document generated electronically. Does not require a seal or signature.