GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	, PG_00052289		
Field of study	Mathematics		
Date of commencement of studies	October 2025	Academic year of realisation of subject	2026/2027
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	3	ECTS credits	4.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Divison of Dynamical Systems -> Institute of Applied Mathematics -> Faculty of Applied Physics and Mathematics -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. inż. Tomasz Szarek	
	Teachers	prof. dr hab. inż. Tomasz Szarek	

Lesson types

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	35.0	100

Subject objectives

The aim of the lecture is to familiarize students with the basic concepts and facts in the field of dynamical systems and the theory of chaos.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_U05] recognize topological structures in mathematical objects occurring, for example, in geometry or mathematical analysis; uses the basic topological properties of sets, functions and transformations, uses the language and methods of functional analysis	The student applies concepts from topology and functional analysis.	[SU1] Assessment of task fulfilment
[K7_U07] at an advanced level and covering modern mathematics, applies and presents in speech and in writing the content and methods of a selected branch of mathematics	The student knows the concepts of dynamical systems and fractal geometry.	[SU1] Assessment of task fulfilment
[K7_W02] has enhanced knowledge of a selected branch of mathematics,theoretical or applied, knows classical definitions and theorems and their proofs and connections with other fields,understands problems being examined	The student knows the Mountain Pass Theorem, the Generalized Ekeland Variational Principle, Sharkovski's Theorem, Kolmogorov's Theorem.	[SW1] Assessment of factual knowledge
[K7_K04] forms opinions on mathematical issues	The student understands the importance of fractal geometry and the theory of dynamical systems	[SK4] Assessment of communication skills, including language correctness

<table>
<tr><td>Subject contents</td><td>Course content – lecture
Examples of fractals. Dimensions: fractal dimension, Hausdorff's dimension and topological dimension. The Barnsley and Hutchinson theory. Feigenbaum's bifurcation. Sharkovski's theorem. Hamiltonian systems. The mountain pass theorem. Generalized variational Ekeland principle. Kolmogorov's theorem.
Course content – seminar
Examples of fractals. Dimensions: fractal dimension, Hausdorff's dimension and topological dimension. The Barnsley and Hutchinson theory. Feigenbaum's bifurcation. Sharkovski's theorem. Hamiltonian systems. The mountain pass theorem. Generalized variational Ekeland principle. Kolmogorov's theorem.</td></tr>
<tr><td>Prerequisites and co-requisites</td><td>Mathematical analysis. Ordinary differential equations. Topology.</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>Test</td><td>50.0%</td><td>50.0%</td></tr>
<tr><td>Multimedia presentation</td><td>100.0%</td><td>50.0%</td></tr>
</table>
</td></tr>
<tr><td>Recommended reading</td><td>
<table>
<tr><td>Basic literature</td><td>1. Jacek Kudrewicz, Fractals and chaos, WNT, Warsaw, 2007 (in Polish)

2. Jean Mawhin, Michell Willem, Critical Points Theory and Hamiltonian Systems, Springer-Verlag, 1989.</td></tr>
<tr><td>Supplementary literature</td><td>H.-O. Peitgen, H. Jürgens, D. Saupe, Chaos and Fractals. New Frontiers of Science, Springer, 2004</td></tr>
<tr><td>eResources addresses</td><td></td></tr>
</table>
</td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td>1. Please provide the definition of a discrete dynamic system/a continuous dynamical system.2. What is an attractor? Please give examples of strange attractors.3. Please calculate the fractal dimension, Hausdorff's dimension and the topological dimension of given fractals.4. Please list the features of fractals.5. What is the Hamiltonian system?6. Please formulate the Mountain Pass Theorem and give its geometric interpretation.7. What is Sharkovski's theorem about?</td></tr>
<tr><td>Practical activites within the subject</td><td>Not applicable</td></tr>
</table>

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