University of Gdańsk

Subject card

Subject name and code	Numerical Modeling of Dynamic Systems, PG_00174267		
Field of study	Mathematical Modeling and Data Analysis		
Date of commencement of studies	October 2023	Academic year of realisation of subject	2025/2026
Education level	Bachelor's studies	Subject group	
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	6.0
Learning profile	academic	Assessment form	exam
Conducting unit			
Name and surname of lecturer (lecturers)	Subject supervisor	dr Paweł Klinga	
	Teachers		

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	30.0	0.0	30.0	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	0.0	0.0	60

Subject objectives

The aim of the course is to introduce the subject of discrete dynamic systems.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[MMiADL3_U11] knows how to arrange and analyse an algorithm in accordance with the specification and save it in the selected programming language	Student addresses the methods presented during the lecture and, using Python, applies the algorithms in order to solve problems.	[SU2] presentation/project/paper/ report
[MMiADL3_U10] is able to recognise problems, including practical issues, that can be solved algorithmically; can make a specification of such a problem	Student recognizes a given dynamic system and chooses an algorithm proper to analyze the issue.	[SU2] presentation/project/paper/ report [SU4] test/exam - oral or written
[MMiADL3_W09] knows and understands the basics of computational and programming techniques supporting mathematician's work and understands their limitations	Student is able to analyze the behavior of a dynamic system using methods presented during the course.	[SW2] presentation/project/paper/ report
[MMiADL3_K02] is ready to precisely formulate questions to deepen his/her own understanding of a given topic or to find missing elements of reasoning	By posing questions on a given problem, the student identifies areas that he/she is able to solve on his own and those in which he needs to deepen his knowledge.	[SK1] oral statement/conversation/ discussion [SK8] observation of student's independent or team work

<table>
<tr><td>Subject contents</td><td>Elementary recurrence relations and their solutions in Python

Leslie model of population distribution

Nonlinear dynamic systems: tent function, logistic map and their graphical iterations

Fixed points and periodic points of discrete dynamic systems and their stability

Bifurcation diagram, Lyapunov exponent

Complex dynamic systems, Julia and Mandelbrot sets

Fractals, fractal dimension</td></tr>
<tr><td>Prerequisites and co-requisites</td><td></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>51.0%</td><td>50.0%</td></tr>
<tr><td>Project</td><td>51.0%</td><td>50.0%</td></tr>
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</td></tr>
<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td>1. Stephen Lynch, Dynamical Systems with Applications using Python, Springer, 2018.
2. G.C. Layek, An Introduction to Dynamical Systems and Chaos, Springer, 2015.</td></tr>
<tr><td>Supplementary literature</td><td>adapted to the implemented project</td></tr>
<tr><td>eResources addresses</td><td></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td>Analysis of a population change in a given Leslie model

Analysis of a long-term behavior of a dynamic system given by a logistic map</td></tr>
<tr><td>Work placement</td><td>Not applicable</td></tr>
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