GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Mathematical modelling and computer simulation , PG_00061485		
Field of study	Mathematics		
Date of commencement of studies	October 2024	Academic year of realisation of subject	2025/2026
Education level	second-cycle studies	Subject group	Obligatory subject group in the field of study 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	Department of Probability Theory and Biomathematics -> Faculty of Applied Physics and Mathematics -> Wydziały Politechniki Gdańskiej		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Anna Szafrańska	
	Teachers	dr inż. Anna Szafrańska	

Lesson types and methods of instruction

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

eNauczanie source addresses:

Moodle ID: 1537 Modelowanie matematyczne i symulacje komputerowe
https://enauczanie.pg.edu.pl/2025/course/view.php?id=1537

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

Getting to know the scope of application of mathematical models for which it is purposeful and possible to build simulation programs. Mastering the techniques of designing, running and testing programs simulations and the interpretation of their results.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_K03] works as a team; understands the necessity of systematic work on all projects that are long-term in nature, understands and appreciates the importance of intellectual honesty in one's own activities and the activities of other people; behaves ethically	Student makes in a small team the design and prototype of a simulation model	[SK2] Assessment of progress of work [SK3] Assessment of ability to organize work [SK1] Assessment of group work skills
[K7_U10] understands the mathematical foundations of the analysis of algorithms and computational processes, constructs algorithms with good numerical properties, used to solve typical and unusual mathematical problems	Student performs the design and prototype of the simulation algorithm, procedures for generating data for simulation and statistical analysis of simulation results.	[SU3] Assessment of ability to use knowledge gained from the subject [SU2] Assessment of ability to analyse information [SU4] Assessment of ability to use methods and tools [SU1] Assessment of task fulfilment
[K7_W04] demonstrates knowledge the rules of stochastic modeling in financial and actuarial mathematics or in natural sciences	Student learns the principles of building deterministic and stochastic models and the functioning of number generators pseudo-random models and their use in creating simulation models (including discrete systems)	[SW2] Assessment of knowledge contained in presentation [SW1] Assessment of factual knowledge
[K7_U09] constructs mathematical models used in specific advanced applications of mathematics, can use stochastic processes as a tool for modeling phenomena and analyzing their evolution,constructs mathematical models used in specific advanced applications of mathematics, uses stochastic processes as a tool for modeling phenomena and analyzing their evolution, recognizes mathematical structures in physical theories	Student makes the design and prototype of the simulation model associated with the specialty studied and using pseudo-random number generators to generate data and statistical methods for analysis of simulation results.	[SU1] Assessment of task fulfilment [SU4] Assessment of ability to use methods and tools

Subject contents

Lectures:
Basic concepts. Building a model: system analysis, making assumptions, selecting an appropriate mathematical equations, preparing the model for analysis (solving equations, estimating parameters). Qualitative and / or quantitative analysis of the constructed model. Sensitivity analysis. Model validation and its application. Comprehensive examples of the construction of models describing biological, physical, medical, engineering systems, etc.
Lab:
Analysis and simulations of discrete and continuous deterministic models. Modeling chaotic phenomena. Deterministic and stochastic modeling.

Prerequisites and co-requisites

nothing requested

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Lecture - quizzes	50.0%	20.0%
Laboratory - project	50.0%	30.0%
Laboratory - test	50.0%	50.0%

Recommended reading

Basic literature	1. U. Foryś, Matematyka w biologii, WTN Warszawa, 2005. 2. M.A.Pinsky, S.Karlin, An Introduction to Stochastic Modeling, Academic Press, 2011. 3. M.Mitzenmacher, U.Upfal, Metody probabilistyczne i obliczenia, WNT, 2009.
Supplementary literature	1. W.R.Gilks, S.Richardson, D.J.Spiegelhalter, Markov Chain Monte Carlo in Practice, Chapman & Hall CRC, 1996. 2. P.Biecek, Przewodnik po pakiecie R, GiS, 2014. 3. J.S.Liu, Monte Carlo Strategies in Scientifing Computing, 2001.
eResources addresses	

Example issues/ example questions/ tasks being completed

Analysis and simulations of a discrete model of the dynamics of Romeo and Juliet's romance.
Analysis and simulations of the predator-prey model with the reduction of environmental resources for the prey. Independent modeling of simple modifications of the predator-prey model, their analysis and simulations.
Deterministic and stochastic modeling of epidemic spread.

Work placement

Not applicable

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