



## Subject card

Subject name and code	Mathematical modelling and computer simulation , PG_00061485						
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			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	Division of Differential Equations and Applications of Mathematics -> Institute of Applied Mathematics -> Faculty of Applied Physics and Mathematics						
Name and surname of lecturer (lecturers)	Subject supervisor		dr inż. Anna Szafrńska				
	Teachers		dr inż. Anna Szafrńska				
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						
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_W09] Knows the rules of stochastic modeling in financial and actuarial mathematics or in natural sciences, in particular physics, chemistry or biology.	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_U11] Can construct mathematical models used in specific advanced applications of mathematics, can use stochastic processes as a tool for modeling phenomena and analyzing their evolution.	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
	[K7_K03] Can work 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_U12] Recognizes mathematical structures (e.g. algebraic, geometric) in physical theories	Student performs a functioning and effective simulation program, using libraries / packages of mathematical functions.	[SU2] Assessment of ability to analyse information
[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 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	
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 deterministic models. Modeling chaotic phenomena. Deterministic vs stochastic modeling.		
Prerequisites and co-requisites	nothing requested		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Laboratory	50.0%	80.0%
	Lecture quizzes	50.0%	20.0%
Recommended reading	Basic literature	1. Kai Velten, Mathematical Modeling and Simulation: Introduction for Scientists and Engineers Author(s), WileyVCH Verlag GmbH & Co. KGaA, 2008 2. U. Forys, Matematyka w biologii, WTN Warszawa, 2005. 3. M.Mitzenmacher, U.Upfal, Metody probabilistyczne i obliczenia, WNT, 2009.	
	Supplementary literature	1. P.Biecek, Przewodnik po pakiecie R, GiS, 2014. 3. J.S.Liu, Monte Carlo Strategies in Scientific Computing, 2001.	
	eResources addresses	Podstawowe <a href="https://enauczanie.pg.edu.pl/moodle/course/view.php?id=30698">https://enauczanie.pg.edu.pl/moodle/course/view.php?id=30698</a> - course Adresy na platformie eNauczanie: Modelowanie matematyczne i symulacje komputerowe (MAT2006/1) - 2024/2025 - Moodle ID: 30698 <a href="https://enauczanie.pg.edu.pl/moodle/course/view.php?id=30698">https://enauczanie.pg.edu.pl/moodle/course/view.php?id=30698</a>	
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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