GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Mathematical modelling and computer simulation - team project, PG_00033105		
Field of study	Mathematics		
Date of commencement of studies	October 2022	Academic year of realisation of subject	2023/2024
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	blended-learning
Year of study	2	Language of instruction	Polish
Semester of study	3	ECTS credits	6.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Department of Probability Theory and Biomathematics -> Faculty of Applied Physics and Mathematics		
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	15.0	0.0	75
	E-learning hours included: 45.0						

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	75	5.0	70.0	150

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	Student makes in a small team the design and prototype of a simulation model	[SK1] Assessment of group work skills [SK3] Assessment of ability to organize work [SK2] Assessment of progress of work
K7_U13	Student performs the design and prototype of the simulation algorithm, procedures for generating data for simulation and statistical analysis of simulation results.	[SU1] Assessment of task fulfilment [SU4] Assessment of ability to use methods and tools [SU2] Assessment of ability to analyse information [SU3] Assessment of ability to use knowledge gained from the subject
K7_W09	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)	[SW1] Assessment of factual knowledge [SW2] Assessment of knowledge contained in presentation
K7_U12	Student performs a functioning and effective simulation program, using libraries / packages of mathematical functions.	[SU2] Assessment of ability to analyse information
K7_U11	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.	[SU4] Assessment of ability to use methods and tools [SU1] Assessment of task fulfilment

Subject contents

Lectures:
Basic concepts. Model construction: system analysis, making assumptions, selecting the appropriate mathematical apparatus, preparing the model for analysis (solving equations, estimating parameters). Dimensional analysis of mathematical models. An approach to the numerical solution of mathematical models. 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 simulation of discrete deterministic models. Modeling of chaotic phenomena. Deterministic vs. stochastic modeling.

Project:
Generating sequences of pseudorandom numbers. Chaotic maps. Deterministic mathematical models.

Prerequisites and co-requisites

nothing requested

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Project 2	50.0%	30.0%
Project 1	50.0%	25.0%
Laboratory tasks	50.0%	45.0%

Recommended reading

Basic literature	1. R.Wieczorkowski, R.Zieliński, Komputerowe generatory liczb losowych, Warszawa: WNT, 1997. 2. U. Foryś, Matematyka w biologii, WTN Warszawa, 2005. 3. M.A.Pinsky, S.Karlin, An Introduction to Stochastic Modeling, Academic Press, 2011. 4. 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	Adresy na platformie eNauczanie: Modelowanie matematyczne i symulacje komputerowe (MAT2006/1) - 2023/2024 - Moodle ID: 30698 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=30698

Example issues/ example questions/ tasks being completed	Lab: Analysis and simulation of a discrete model of the dynamics of Romeo and Juliet's romance. Analysis and simulations of the predator-prey model with limitation of environmental resources for prey. Independent modeling of simple modifications of the predator-prey model, their analysis and simulations. Implementation, analysis and comparison of deterministic and stochastic models. Design: Generating sequences of pseudorandom numbers with given distributions and their applications. Chaotic maps in image coding. Short- and long-term simulation analysis of a mathematical model describing the phenomenon of epidemic spread.
Work placement	Not applicable