GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Introduction to modeling physical phenomena, PG_00051067		
Field of study	Technical Physics		
Date of commencement of studies	October 2026	Academic year of realisation of subject	2027/2028
Education level	first-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	3.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Institute of Physics and Applied Computer Science -> Faculty of Applied Physics and Mathematics -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Ewa Erdmann	
	Teachers		

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	15.0	0.0	15.0	15.0	0.0	45

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	45	2.0	28.0	75

Subject objectives

The goal is to teach the student programming with the use of scientific libraries implemented for the selected programming language; to implement the mathematical model of the selected physical phenomenon in the form of a desktop application; to creation of documentation containing specification of requirements and system design.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_W05] has knowledge of programming methodologies and techniques, as well as the use of selected IT tools in physics and engineering.	The student has a basic knowledge of the methodology and techniques of programming in the python programming language and associated scientific libraries that allow solving various problems in the topic of modelling physical phenomena.	[SW1] Assessment of factual knowledge [SW3] Assessment of knowledge contained in written work and projects
[K6_U02] is able to analyse and solve complex and non-standard scientific and technical problems using appropriate analytical, computational, numerical, simulation or experimental methods.	The student is able to analyze and solve simple scientific and technical problems through the implementation of mathematical models of physical phenomena in the form of computer simulation and the analysis of the obtained results.	[SU1] Assessment of task fulfilment
[K6_K01] demonstrates readiness for continuous learning and updating knowledge in physics and related fields, critically evaluating it and recognising its importance in solving practical and theoretical problems.	The student is ready to continuously develop competences in the field of modeling physical phenomena using computational methods, critically assessing available scientific tools and libraries, and consciously selecting these resources for specific problems.	[SK2] Assessment of progress of work [SK4] Assessment of communication skills, including language correctness

Subject contents

Course content – lecture

Real objects versus physical and mathematical models. Interpreted vs compiled languages. Basic elements of Python syntax: complex built-in types, function definition, description of file operations, error handling. External libraries: numpy, scipy, matplotlib. Project documentation. Examples of projects modeling physical phenomena. Limitations of the possibilities of simulating physical phenomena

Course content – laboratory

During computer laboratory, the content presented in the lecture is put into practice in the form of short programming problems, e.g. creating a function that counts specific terms of the Fibonacci sequence or downloading data from a file, analyzing specific information and presenting the result in the console or a chart.

Course content – project

Writing clear project documentation in accordance with software development standards. Implementing a selected physical model/phenomenon, such as the superposition of harmonic vibrations, a double pendulum, the photoelectric effect, or the motion of a charged particle in a magnetic field.

Prerequisites and co-requisites

Knowledge of the subject Programming languages (PG_00058047)

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Written exam testing the lecture knowledge	50.0%	40.0%
Project implementation and presentation	50.0%	30.0%
Solution of the lab problems	50.0%	30.0%

Recommended reading

Basic literature	A. B. Downey, J. Elkner, C. Meyers, Think Python. How to Think Like a Computer Scientist" http://greenteapress.com/thinkpython2/thinkpython2.pdf Richard P. Feynman The Feynman Lectures on Physics
Supplementary literature	T.R. Padmanabhan "Programming with Python"
eResources addresses	

Example issues/ example questions/ tasks being completed

Lecture:
1. Explain the difference between an interpreted and a compiled programming language. What are the benefits of writing programs using an interpreted language?
2. What does it mean that a built-in type is "mutable"? Give an example of a mutable data type in Python.
3. Give examples and describe the operations allowed on the list data type.
4. What is the def keyword for? Describe the syntax and rules for its use.

Computer labs:
1. Write a program that returns the smallest value of all positional arguments using the construction of redundant arguments (*args). If any argument is not of a numeric type, display a message about invalid data type. Don't use the build-in max() function.
2. Generate 50 random points (x, y) where x is the first ten natural numbers and y = $3x^2 + 2x + C$, where C is an integer C [-10, 10]. Fit a second-degree polynomial to the data using numpy library and plot the original points and the fitted curve.
3. On a rectangular PCB with the temperature distribution $f(x_1,x_2)$ find the lowest temperature and coordinates where it appears in the area x_1[0, 0.5] i x_2[0, 3]. Solve using the scipy library.
$f(x_1,x_2) = [(x_2 + 2,5)^2 - (x_1 - 1)^2] * \sin(x_1^2 + x_2^2)$

Projects:
1. 2D fluid simulation using the Navier-Stokes equations.
2. Investigation of the 2D electric field distribution for various elect
3. Interactive visualization of body motion on an inclined plane.

Practical activites within the subject

Not applicable