



Subject card

Subject name and code	Basic of Modeling, Simulation and Optimisation Methods, PG_00067189						
Field of study	Smart Renewable Energy Engineering						
Date of commencement of studies	October 2026	Academic year of realisation of subject				2026/2027	
Education level	second-cycle studies	Subject group				Optional subject group 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	1	Language of instruction				English	
Semester of study	1	ECTS credits				6.0	
Learning profile	general academic profile	Assessment form				assessment	
Conducting unit	Division of Applied Computer Science -> Institute of Naval Architecture -> Faculty of Mechanical Engineering and Ship Technology -> Faculties of Gdańsk University of Technology						
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Aleksander Kniat					
	Teachers						
Lesson types	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: 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	75		9.0		66.0	150
Subject objectives	The aim of the subject is to apply mathematical modelling for solving physical problems. In particular subject includes numerical methods and enhances the skills to create algorithms/computer programs, as well as using ready-made software tools to perform simulations.						
Learning outcomes	Course outcome		Subject outcome		Method of verification		
	[K7_W101] is able to make an in-depth identification of key objects and phenomena related to the field of study, as well as theories that describe them and applicable analytical and design methods		Student is able to describe physical phenomena with differential equation and propose a numerical solution method.		[SW1] Assessment of factual knowledge		
	[K7_U01] is able to apply analytical thinking and solve technical problems related to renewable energy systems, including wind power, using engineering methodologies		Student knows principles of algorithm creation and uses structural/objective programming language to implement algorithms.		[SU1] Assessment of task fulfilment [SU4] Assessment of ability to use methods and tools		
	[K7_K01] is prepared to evaluate projects and operations in wind energy systems, demonstrating competencies in designing and optimizing renewable energy systems, including wind power		Student is able to optimize selected part of a wind/renewable energy system according to a chosen criterion.		[SK1] Assessment of group work skills [SK5] Assessment of ability to solve problems that arise in practice		

Subject contents	<p>Course content – lecture</p> <ol style="list-style-type: none"> 1. Problem Formulation & System Abstraction defining abstract notions to create algorithm - methods to write/depict algorithm (flow chart, pseudo-code) 2. Mathematical Model Building building simple mathematical models of physical phenomena and coding in Python (e.g. motion equation) 3. Model Verification & Validation verification & validation examples (e.g. finding roots of a function - bisection method, Newton's method) 4. Simulation Fundamentals describing a process or physical phenomenon with an equations (possibly differential equation, Euler's & Runge-Kutta methods) 5. Data & Parameters using Python language to parametrize simulations, working with data sets 6. Optimisation Problem Formulation local extremes vs. global extremes, continuous and discrete approach 7. Core Optimisation Methods Newton-Raphson's method, Lagrange multipliers method, Monte Carlo methods: GA etc. 8. Sensitivity & Uncertainty Analysis using parameters to verify sensitivity & uncertainty 9. Interpolation polynomial and spline interpolation 		
Prerequisites and co-requisites	<ul style="list-style-type: none"> • fundamental skills in using personal computer, • basic knowledge about operating system and file system, • bachelor's course in mathematics. 		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	tests in lab	60.0%	100.0%
Recommended reading	Basic literature		<p>Chapra S., Clough D., Applied Numerical Methods with Python for Engineers and Scientists, 1st Edition, Mc Graw Hill, 2022</p> <p>Moin P., Fundamentals of Engineering Numerical Analysis, Cambridge University Press, 2-nd Edition, 2010</p>
	Supplementary literature		Bjorck A., Dahlquis G., Numerical methods, Dover Publications Inc., Prentice Hall, 1974
	eResources addresses		
Example issues/ example questions/ tasks being completed	<ol style="list-style-type: none"> 1. <i>Solving one dimensional physical problems defined with differential equation e.g.:</i> <ul style="list-style-type: none"> <i>damping oscillations of a mass hanged on spring,</i> <i>damping oscillations of a cylinder fallen into water</i> 2. <i>Interpolation with Lagrange polynomial</i> 3. <i>Interpolation with Splines</i> 		
Practical activites within the subject	Not applicable		

Document generated electronically. Does not require a seal or signature.