University of Gdańsk

Subject card

Subject name and code	Numerical methods and programming - laboratory exercises, PG_00091526		
Field of study	Water Management and Protection of Water Resources		
Date of commencement of studies	October 2024	Academic year of realisation of subject	2025/2026
Education level	Bachelor's studies	Subject group	Obligatory subject group in the field of study Subject group related to scientific research in the field of study Subject group related to practical vocational preparation
Mode of study	full-time studies	Mode of delivery	at the university
Year of study	2	Language of instruction	Polish
Semester of study	4	ECTS credits	3.0
Learning profile	practical	Assessment form	credit
Conducting unit	Laboratory of Physical Oceanography -> Department of Physical Oceanography and Climate Research -> Faculty of Oceanography and Geography -> Rector		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. Wiesław Miklaszewski, prof. UG	
	Teachers	dr hab. Wiesław Miklaszewski, prof. UG	

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	0.0	0.0	45.0	0.0	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	7.0	30.0	82

Subject objectives

Master the skills of: creating and managing code in an integrated programming environment; creating computer programs using library functions, basic standard input and output functions, control instructions; implementing custom functions, implementing algorithms that operate on arrays; using numerical libraries; creating programs based on the object-oriented programming paradigm;

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[GWOZWL3-U07] use literature and other available sources of information, including information technology, multimedia, Internet, databases, and select and critically evaluate information	K_U07 - use the literature and other available sources of information, including information technology, multimedia, Internet resources, databases, and to select and critically evaluate information	[SU2] presentation/project/paper/ report [SU3] text preparation/written work [SU5] implementation of a problem task
	[GWOZWL3-U08] use basic mathematical and statistical methods to analyze data and describe phenomena and processes occurring in the environment, as well as methods of information technology to assess the risk of threats to the of the environment, especially the hydrosphere	K_U08 - use basic computer programming as a method for data analysis and description of phenomena and processes occurring in the environment, as well as for risk assessment of environmental hazards, especially the hydrosphere	[SU2] presentation/project/paper/ report [SU3] text preparation/written work [SU5] implementation of a problem task
	[GWOZWL3-U03] observe and describe the changes taking place in water management and predict further directions of its development as well as conduct a critical analysis of: case studies of problems of water management and protection of water resources in terms of impact on ecological, social and economic systems natural valorization and assessment of quality of the environment	K_U03 - can apply to a basic degree computer programming in the process of natural valorization and environmental quality assessment	[SU2] presentation/project/paper/ report [SU3] text preparation/written work [SU5] implementation of a problem task
	[GWOZWL3-K03] systematic further education and professional development, updating and expand their knowledge and skills, understands the limitations of his own knowledge in the context of civilization progress and recognizes authorities in the professional and scientific environment	K_K03 - is ready for systematic further education and professional development, updating and expanding his knowledge and skills in the field of computational methods and programming languages, understands the limitations of his own knowledge in the context of the progress of civilization and recognizes the authorities in the professional and scientific environment	[SK2] presentation/project/paper/ report [SK3] text preparation/written work [SK5] implementation of a problem task
	[GWOZWL3-W04] research techniques, methods and tools currently used in water management and protection of water resources both in the field of natural sciences and social sciences, including basic statistical and information technology tools that make it possible to describe, model and interpret data on phenomena and processes occurring in the aquatic environment, as well as tools for describing relationships in social-ecological systems	K_W04 - knows and understands basic programming to describe, model and interpret data on phenomena and processes in the aquatic environment and to describe relationships in social-ecological systems	[SW2] presentation/project/paper/ report [SW3] text preparation/written work [SW5] implementation of a problem task

Subject contents	1. Python distributions (Anaconda). 2. Integrated development environment (Python: Spyder - editor, console, variable explorer, plots). 3. Scripts, data types, code elements, keywords, identifiers, operators, literals, comments. 4. Libraries: importing, library functions, numerical libraries: numpy i scipy; graphics library - matplotlib.pyplot. 5. Control instructions: loops (for, while), conditional statements. 6. Defining functions: lambda construction, local and global variables. 7. Lists: lists, tuples; list operations, np.arrays - vectors and matrices representation, linear algebra algorithms. 8. Accessing data files - basic input/output. 9. Numerical calculations: computer arithmetic - sources of errors; roots of nonlinear equations (Python: scipy.optimize.fsolve), interpolation (Python: numpy.polyfit, numpy.polyval, scipy.Cubic.Spline), linear least squares (Phyton, numpy.polyfit), numerical integration (Python: scipy.integrate.trapezoid, scipy.integrate.quad), generation of pseudorandom numbers (Python: numpy.random), linear systems of equations (Python: numpy.linalg, scipy.linalg), initial value problem for ordinary differential equations (Python: scipy.integrate.solve_ivp). 11. Introduction to object-oriented programming: classes/methods. 12. Scientific reports: rules, mathematical formulae, plots.
Prerequisites and co-requisites	
Assessment methods and criteria	

Subject passing criteria	Passing threshold	Percentage of the final grade
Projekt (min. 7.75pkt/max. 15.pkt.).	51.0%	60.0%
Homework assessment (max. 5pkt).	0.0%	20.0%
Homework assessment (max. 5pkt).	0.0%	20.0%

Recommended reading	Basic literature	1. F. Bittmann, Python 3 for Science and Engineering Applications, Elektor International Media BV 2020. 2. D. E. Clough, S. C. Chapra, Engineering and Scientific Computing with Python, CRC Press 2023. 3. H. Fangohr, Introduction to Python for Computational Science and Engineering 2024, Introduction to Python for Computational Science and Engineering (fangohr.github.io). 4. J. V. Guttag, Introduction to Computation and Programming Using Python, The MIT Press 2021. 5. H. P. Langtangen, A Primer on Scientific Programming with Python, Springer-Verlag Berlin Heidelberg 2016. 6. J. Ernesti, P. Kaiser, Python 3, Rheinwerk Publishing 2022. 7. J. Keyser, How to Program, The Teaching Company 2016. 8 B. Korites, Python Graphics, Apress Media 2023. 9. G. Kumar, A. S. Kushwaha, R. R. Nair, S. G, A Journey to Core Python, BPB Publications 2022.
	Supplementary literature	1. E. B. M. Bashier, Practical Numerical and Scientific Computing with MATLAB® and Python, Taylor & Francis 2020. 2. J. M. Kinser, Modeling and Simulation in Python, CRC Press 2022. 3. B. Jayne, Python Standard Library, BarCharts Publishing 2020.
	eResources addresses	
Example issues/ example questions/ tasks being completed		
Work placement	Not applicable	

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