

Subject card

Subject name and code	Programming and Data Analysis Methods - laboratory, PG_00206210						
Field of study	Oceanography						
Date of commencement of studies	October 2026	Academic year of realisation of subject			2026/2027		
Education level	Master's studies	Subject group			Obligatory subject group in the field of study Optional subject group		
Mode of study	full-time studies	Mode of delivery			at the university		
Year of study	1	Language of instruction			Polish		
Semester of study	1	ECTS credits			4.0		
Learning profile	academic	Assessment form			credit		
Conducting unit	Laboratory for Physics Teaching -> Institute of Experimental Physics -> Faculty of Mathematics, Physics and Informatics -> Rector						
Name and surname of lecturer (lecturers)	Subject supervisor		dr Adrian Kołodziejski				
	Teachers						
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		5.0		50.0	100
Subject objectives	Mastering advanced programming techniques in selected language; proficiency in time series and spatial data visualisation, analysis and interpolation; ability to work with large datasets, competence in the application of selected linear algebra techniques.						
Learning outcomes	Course outcome		Subject outcome		Method of verification		
	[OCEANMU2-W03] has an in-depth understanding of research methods used in oceanography and related sciences, and interprets their mechanisms and interrelationships across different spatial and temporal scales		knows and understands programming techniques used to visualize, analyze and interpolate oceanographical data; is able to use relevant numerical algebra techniques.		[SW4] test/exam - oral or written [SW5] implementation of a problem task		
	[OCEANMU2-U06] is able to use specialized computer software as well as advanced mathematical and statistical methods to analyze data and describe processes and phenomena occurring in the marine and coastal environment; evaluates their reliability and usefulness and performs critical analysis		can use advanced programming techniques and mathematical methods in data analysis and description of processes and phenomena occurring in the marine environment and coastal zone		[SU4] test/exam - oral or written [SU5] implementation of a problem task		
	[OCEANMU2-U11] is able to work individually and cooperate in laboratory and field groups, performs various functions in them, including managerial ones, performs various assigned tasks		is able to work individually and cooperate in computer laboratory groups, performs various functions in them, including managerial ones, performs various assigned tasks		[SU4] test/exam - oral or written [SU5] implementation of a problem task		

Subject contents	<p>1. Fundamental principles and concepts of programming in Python. Advanced aspects of the Jupyter Notebook environment and script-based programming.</p> <p>2. Operations on multidimensional arrays using numerical libraries NumPy and SciPy. Vectorization of computations and broadcasting mechanisms. Matrix algebra: matrix multiplication, solving systems of linear equations, eigenvalues and eigenvectors, matrix decompositions (introduction to SVD).</p> <p>3. Working with large datasets. Reading, processing, and writing data in formats commonly used in oceanography (including CSV and HDF5). Use of pandas and xarray libraries for handling tabular and multidimensional data. Time series processing, handling missing data, data aggregation, and filtering.</p> <p>4. Visualization of time series and two- and three-dimensional fields. Use of advanced features of the Matplotlib library.</p> <p>5. One-dimensional and two-dimensional interpolation methods (linear interpolation, polynomial interpolation, splines).</p> <p>6. Selected techniques of time series analysis, data filtering and smoothing. Introduction to spectral analysis (FFT).</p> <p>7. Data clustering methods (k-means and DBSCAN algorithms), dimensionality reduction (PCA) as an application of linear algebra in environmental data analysis.</p>											
Prerequisites and co-requisites												
Assessment methods and criteria	<table border="1"> <thead> <tr> <th data-bbox="456 618 794 645">Subject passing criteria</th> <th data-bbox="799 618 1137 645">Passing threshold</th> <th data-bbox="1142 618 1469 645">Percentage of the final grade</th> </tr> </thead> <tbody> <tr> <td data-bbox="456 651 794 678">final written examination</td> <td data-bbox="799 651 1137 678">51.0%</td> <td data-bbox="1142 651 1469 678">60.0%</td> </tr> <tr> <td data-bbox="456 685 794 712">in-class problem solving</td> <td data-bbox="799 685 1137 712">51.0%</td> <td data-bbox="1142 685 1469 712">40.0%</td> </tr> </tbody> </table>			Subject passing criteria	Passing threshold	Percentage of the final grade	final written examination	51.0%	60.0%	in-class problem solving	51.0%	40.0%
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final written examination	51.0%	60.0%										
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Recommended reading	Basic literature	<ul style="list-style-type: none"> Kong Q., Siau T., Bayen A., 2020. Python Programming and Numerical Methods: A Guide for Engineers and Scientists, Academic Press, McKinney W. 2023 - Python for Data Analysis, Helion (in Polish) Cohen, M., X., 2024. Practical Linear Algebra for Data Science: From Core Concepts to applications using Python. Helion (in Polish) Emery W., Thomson R., 2024. Data Analysis Methods in Physical Oceanography, Elsevier Science (or previous editions) 										
	Supplementary literature	<ul style="list-style-type: none"> Saha, A. 2015. Doing math in Python: Use Programming to Explore Algebra, Calculus and More! Helion (in Polish) VanderPlas J., 2023 - Python Data Science Handbook: Essential Tools for Working with Data, Helion (in Polish) Talley D. et al, 2011 - Descriptive Physical Oceanography, Edition 6 										
	eResources addresses	<p>Basic</p> <p>https://pygis.io/docs/e_interpolation.html - PyGIS library for spatial interpolation</p> <p>https://pythonnumericalmethods.studentorg.berkeley.edu/notebooks/Index.html - Kong Q., Siau T., Bayen A., Python Programming and numerical methods, Berkeley, 2020,</p>										
Example issues/ example questions/ tasks being completed	Find an inverse of a matrix											
Work placement	Not applicable											

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