

**Subject card**

<b>Subject name and code</b>	Mathematical Methods in Oceanography - laboratory, PG_00206209						
<b>Field of study</b>	Oceanography						
<b>Date of commencement of studies</b>	October 2026	<b>Academic year of realisation of subject</b>			2026/2027		
<b>Education level</b>	Master's studies	<b>Subject group</b>			Obligatory subject group in the field of study Optional subject group		
<b>Mode of study</b>	full-time studies	<b>Mode of delivery</b>			at the university		
<b>Year of study</b>	1	<b>Language of instruction</b>			Polish		
<b>Semester of study</b>	1	<b>ECTS credits</b>			3.0		
<b>Learning profile</b>	academic	<b>Assessment form</b>			credit		
<b>Conducting unit</b>	Division of Mathematical Methods of Physics -> Institute of Theoretical Physics and Astrophysics -> Faculty of Mathematics, Physics and Informatics -> Rector						
<b>Name and surname of lecturer (lecturers)</b>	<b>Subject supervisor</b>		dr Krzysztof Szczygielski				
	<b>Teachers</b>						
<b>Lesson types</b>	<b>Lesson type</b>	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	<b>Number of study hours</b>	0.0	0.0	45.0	0.0	0.0	45
	E-learning hours included: 0.0						
<b>Learning activity and number of study hours</b>	<b>Learning activity</b>	Participation in didactic classes included in study plan		Participation in consultation hours		Self-study	SUM
	<b>Number of study hours</b>	45		2.0		28.0	75
<b>Subject objectives</b>	Students will become proficient in matrix algebra and index notation; will be introduced to vector calculus in curvilinear coordinates; will be able to calculate Fourier transforms and solve most frequent types of differential equations, using relevant software.						

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[OCEANMU2-K03] is ready to effectively organize his/her own work, is active and persistent and punctuality in completing tasks, is ready to carrying out evaluation of their own activities	is ready to effectively organize his/her own work while applying mathematical methods, is active and persistent and punctual in completing tasks, is ready to evaluate their own activities	[SK4] test/exam - oral or written [SK5] implementation of a problem task
	[OCEANMU2-W01] knows and understands in-depth specialized terminology used in oceanography and related sciences (in Polish and a selected foreign language)	knows and understands in-depth specialized, mathematical terminology used while applying mathematical methods to solve oceanographical problems (in Polish and a English)	[SW4] test/exam - oral or written [SW1] oral statement/ conversation/discussion
	[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, in-depth, mathematical methods and techniques used in oceanography	[SW4] test/exam - oral or written [SW1] oral statement/ conversation/discussion [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 mathematical methods in data analysis and modelling of processes and phenomena occurring in the marine environment and coastal zone	[SU4] test/exam - oral or written [SU5] implementation of a problem task	
Subject contents	<p>A series of problems solved with analytical techniques and symbolic calculations on:</p> <ul style="list-style-type: none"> <li>selected topics in linear algebra; index notation;</li> <li>vector field analysis and volume, calculation of surface and line integrals, integral theorems applications;</li> <li>curvilinear coordinate systems and application of differential operators in curvilinear coordinate systems;</li> <li>introductory aspects of tensor analysis;</li> <li>the Fourier transform;</li> <li>solving selected types of ordinary and partial differential equations.</li> </ul>		
Prerequisites and co-requisites			
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	in-class discussions	51.0%	10.0%
	final written test	51.0%	70.0%
	in-class assignments	51.0%	20.0%
Recommended reading	Basic literature	<ul style="list-style-type: none"> <li>Karaśkiewicz E., 1974. An Outline of Vector and Tensor Theory, PWN (in Polish)</li> <li>Byron F.W., Fuller R.W., 1975. Mathematics in classical and quantum physics, tom 1, PWN (in Polish)</li> <li>Sirovich L., 1998, Introduction to applied mathematics, Springer-Verlag</li> <li>Cohen M., 2024. Practical Linear Algebra for Data Science. From Core Concepts to Applications Using Python. Helion (in Polish)</li> </ul>	
	Supplementary literature	<ul style="list-style-type: none"> <li>Arfken, G.B., Weber H.J., Harris F.E., 2012. Mathematical methods for Physicists: A comprehensive guide (selected chapters)</li> <li>Strzelecki, 2006, A short introduction to differential equations, University of Warsaw Press (in Polish) Wydawnictwo Uniw. Warszawskiego (or alternative)</li> <li>Boelkins M.R, Goldberg J.L., Potter M., 2009, Differential Equations with Linear Algebra, Oxford University Press</li> <li>Aris R., 1989. Vectors, tensors and the basic equations of fluid mechanics. Dover Publ. (chapters 1-4; very condensed, heavy and generally not suitable as a first read, but a good indication of topics needed in cartesian tensors)</li> </ul>	
	eResources addresses		
Example issues/ example questions/ tasks being completed	<p>calculate the surface integral</p> <p>calculate the Fourier transform of a given function</p>		

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