University of Gdańsk

Subject card

Subject name and code	Numerical Modelling - laboratory, PG_00206219						
Field of study	Oceanography						
Date of commencement of studies	October 2026		Academic year of realisation of subject		2027/2028		
Education level	Master's studies		Subject group		Obligatory subject group in the field of study 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	2		Language of instruction		Polish		
Semester of study	3		ECTS credits		4.0		
Learning profile	academic		Assessment form		credit		
Conducting unit							
Name and surname of lecturer (lecturers)	Subject supervisor		dr Marek Kowalewski				
	Teachers						
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	0.0	0.0	60.0	0.0	0.0	60
	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	60		2.0		38.0	100
Subject objectives	Introduction to applications of numerical methods to physical oceanography including discretisation of simple differential equations and general information on the use of numerical models in physical oceanography						

Learning outcomes

Course outcome	Subject outcome	Method of verification
[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 terminology used in numerical modelling, especially as used in oceanography. (in Polish and English)	[SW2] presentation/project/paper/ report
[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	The student is ready to effectively organize his/her own work with numerical modelling techniques, is active, persistent and punctual in completion tasks.	[SK2] presentation/project/paper/ report
[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	The student knows and understands in-depth selected techniques and aspects of the use of numerical modelling in oceanography	[SW2] presentation/project/paper/ report
[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 numerical modelling techniques in data analysis and description of processes occurring in the marine environment and coastal zone	[SU2] presentation/project/paper/ report
[OCEANMU2-K01] is ready to plan, implement and supervise, individually or collectively, next stages of the entrusted task, is ready to take responsibility for its results;	is prepared to plan, supervise and punctually deliver individual and group tasks associated with the use of numerical modelling, feels responsible for the results and effects of the work undertaken	[SK2] presentation/project/paper/ report

Subject contents

1. Numerical integration of functions, open and closed Newton-Cotes formulas, the trapezoidal rule, and Simpson's rule.
2. Solving ordinary differential equations. Discrete representation of a continuous variable. Differential derivatives approximation of derivatives on a discrete grid. Properties of the differential scheme: consistency, accuracy, stability, and efficiency.
3. Classification of partial differential equations. Examples of typical equations found in oceanography: hyperbolic equations (wave equation, advection equation), elliptic equations (Laplace, Poisson), and parabolic equations (diffusion equation).
4. Construction of simple models: one-dimensional (e.g., heat diffusion in a water column) and two-dimensional (e.g., the advection-diffusion model).
5. The Monte Carlo method.
6. Neural networks "black-box" models.

Prerequisites and co-requisites

Passing grade in "Programming and data analysis" OR ability to demonstrate good command of the programming langauge used in the course.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Reports from practical exercises	51.0%	100.0%

Recommended reading

Basic literature	R.H. Stewart, *Introduction to Physical Oceanography*, Texas T&M University, 2008
Supplementary literature	Potter, D. E. (1973). *Computational Physics*. Wiley, London.
eResources addresses	Basic https://open.umn.edu/opentextbooks/textbooks/20 - Stewart, Introduction to Physical Oceanography,

Example issues/ example questions/ tasks being completed

Development of a one-dimensional model of heat diffusion in a water column

Work placement

Not applicable

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