University of Gdańsk

Subject card

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|---|---|---|---|
| Subject name and code | Mathematical Methods in Oceanography - laboratory, PG_00206209 | | |
| 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<br>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 | 3.0 |
| Learning profile | academic | Assessment form | credit |
| Conducting unit | Division of Mathematical Methods of Physics -> Institute of Theoretical Physics and Astrophysics -> Faculty of Mathematics, Physics and Informatics -> Rector | | |
| Name and surname of lecturer (lecturers) | Subject supervisor | dr Krzysztof Szczygielski | |
| | 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 | 2.0 | 28.0 | 75 |

**Subject objectives**

Students will became 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,<br>is active and persistent and punctuality in completing tasks, is ready to<br>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<br>[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<br>[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<br>[SW1] oral statement/ conversation/discussion<br>[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<br>[SU5] implementation of a problem task |

## Subject contents

A series of problems solved with analytical techniques and symbolic calculations on:

- selected topics in linear algebra; index notation;
- vector field analysis and volume, calculation of surface and line integrals, integral theorems applications;
- curvilinear coordinate systems and application of differential operators in curvilinear coordinate systems;
- introductory aspects of tensor analysis;
- the Fourier transform;
- solving selected types of ordinary and partial differential equations.

## 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

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| Basic literature | • Karaśkiewicz E., 1974. An Outline of Vector and Tensor Theory, PWN (in Polish)<br>• Byron F.W., Fuller R.W., 1975. Mathematics in classical and quantum physics, tom 1, PWN (in Polish)<br>• Sirovich L., 1998, Introduction to applied mathematics, Springer-Verlag<br>• Cohen M., 2024. Practical Linear Algebra for Data Science. From Core Concepts to Applications Using Python. Helion (in Polish) |
| Supplementary literature | • Arfken, G.B., Weber H.J., Harris F.E., 2012. Mathematical methods for Physicists: A comprehensive guide (selected chapters)<br>• Strzelecki, 2006, A short introduction to differential equations, University of Warsaw Press (in Polish) Wydawnictwo Uniw. Warszawskiego (or alternative)<br>• Boelkins M.R, Goldberg J.L., Potter M., 2009, Differential Equations with Linear Algebra, Oxford University Press<br>• 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) |
| eResources addresses | |

## Example issues/ example questions/ tasks being completed

calculate the surface integral

calculate the Fourier transform of a given function

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| Work placement | Not applicable |

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