GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

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|---|---|---|---|
| Subject name and code | Mathematical modeling and optimization, PG_00065615 | | |
| Field of study | Naval Architecture and Offshore Structures | | |
| Date of commencement of studies | February 2025 | Academic year of realisation of subject | 2024/2025 |
| Education level | second-cycle studies | Subject group | Obligatory subject group in the field of study<br>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 | 1 | Language of instruction | English |
| Semester of study | 1 | ECTS credits | 4.0 |
| Learning profile | general academic profile | Assessment form | assessment |
| Conducting unit | Institute of Ocean Engineering and Ship Technology -> Faculty of Mechanical Engineering and Ship Technology | | |
| Name and surname of lecturer (lecturers) | Subject supervisor | dr inż. Aleksander Kniat | |
| | Teachers | dr inż. Aleksander Kniat<br>dr inż. Paweł Chodnicki | |

**Lesson types and methods of instruction**

| Lesson type | Lecture | Tutorial | Laboratory | Project | Seminar | SUM |
|---|---|---|---|---|---|---|
| Number of study hours | 30.0 | 0.0 | 0.0 | 30.0 | 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 | 10.0 | 30.0 | 100 |

**Subject objectives**

The aim of the subject is to apply mathematical modelling for solving physical problems. In particular subject includes numerical methods and enhances the skills to create algorithms / computer programs, as well as using ready-made software tools to perform simulations in shipbuilding.

**Learning outcomes**

| Course outcome | Subject outcome | Method of verification |
|---|---|---|
| [K7_U15] evaluates the feasibility of advanced methods and tools for solving complex engineering tasks of a practical nature, characteristic of the field of study, and selects and applies appropriate methods and tools for this purpose | Student is able to describe physical phenomena with differential equation and propose a numerical solution method. | [SU4] Assessment of ability to use methods and tools<br>[SU1] Assessment of task fulfilment |
| [K7_W02] demonstrates structured and theory supported knowledge encompassing key issues in the field of Naval Architecture and Ocean Engineering, enabling modeling and analysis of shipborne and offshore systems, devices, and processes | Student knows principles of algorithm creation and uses structural/ objective programming language to implement algorithms. | [SW1] Assessment of factual knowledge |

<table>
<tr><td>Subject contents</td><td>searching for zeros of functions:<br>bisection method<br>Newton's method<br><br>searching for local minimum/maximum:<br>Newton's method<br>Lagrange multipliers method<br><br>numerical integration:<br>square/trapezium method<br>Simpson's method<br><br>solving differential equations:<br>Euler's method<br>Runge-Kutta method<br><br>interpolation:<br>polynomial (Lagrange's polynomial)<br>splines</td></tr>
<tr><td>Prerequisites and co-requisites</td><td>1. fundamental skills in using personal computer,<br>2. basic knowledge about operating system and file system,<br>3. bachelor's course in mathematics</td></tr>
<tr><td>Assessment methods and criteria</td><td><table><tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr><tr><td>exercises</td><td>60.0%</td><td>100.0%</td></tr></table></td></tr>
<tr><td>Recommended reading</td><td><table><tr><td>Basic literature</td><td>Chapra S., Clough D., Applied Numerical Methods with Python for Engineers and Scientists, 1st Edition, Mc Graw Hill, 2022<br><br>Moin P., Fundamentals of Engineering Numerical Analysis, Cambridge University Press, 2-nd Edition, 2010<br><br>Bjorck A., Dahlquis G., Numerical methods, Dover Publications Inc., Prentice Hall, 1974</td></tr><tr><td>Supplementary literature</td><td>Nocedal J., Wright S., Numerical Optimization, Springer Science & Business Media, 2006<br><br>Robinson R.C., Introduction to Mathematical Optimization, Northwestern University, 2013</td></tr><tr><td>eResources addresses</td><td>Podstawowe<br>http://numerics.stanford.edu/ta/index.html - Fundamentals of Engineering Numerical Analysis<br>https://pythonnumericalmethods.studentorg.berkeley.edu/notebooks/Index.html - Python programming and numerical methods<br>Uzupełniające<br>Adresy na platformie eNauczanie:</td></tr></table></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td>1. Solving one dimensional physical problems defined with differential equation e.g.:<br>damping oscillations of a mass hanged on spring,<br>damping oscillations of a cylinder fallen into water<br><br>2. Interpolation with Lagrange polynomial<br><br>3. Interpolation with Splines</td></tr>
<tr><td>Work placement</td><td>Not applicable</td></tr>
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