GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

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|---|---|---|---|
| Subject name and code | Applications of mathematical methods in physics and engineering, PG_00037273 | | |
| Field of study | Technical Physics | | |
| Date of commencement of studies | October 2022 | Academic year of realisation of subject | 2024/2025 |
| Education level | first-cycle studies | Subject group | Optional subject group<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 | 3 | Language of instruction | Polish |
| Semester of study | 6 | ECTS credits | 4.0 |
| Learning profile | general academic profile | Assessment form | assessment |
| Conducting unit | Division of Atomic, Molecular and Optical Physics -> Institute of Physics and Applied Computer Science -> Faculty of Applied Physics and Mathematics | | |
| Name and surname of lecturer (lecturers) | Subject supervisor | dr inż. Sebastian Bielski | |
| | Teachers | dr inż. Sebastian Bielski | |

**Lesson types and methods of instruction**

| Lesson type | Lecture | Tutorial | Laboratory | Project | Seminar | SUM |
|---|---|---|---|---|---|---|
| Number of study hours | 30.0 | 30.0 | 0.0 | 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 | 5.0 | 35.0 | 100 |

**Subject objectives**

The aim of the course is to present and to systematize some mathematical objects, definitions or methods as tools that can be used to solve physical problems. Another aim is to develop the skills of solving problems of physics.

**Learning outcomes**

| Course outcome | Subject outcome | Method of verification |
|---|---|---|
| K6_W02 | Students describe some problems of mechanics, electricity and magnetism, atomic and molecular physics. | [SW3] Assessment of knowledge contained in written work and projects |
| K6_U02 | Students apply the mathematical concepts and methods they have learnt to solve selected problems concerning mechanics, electrodynamics, heat transfer, quantum mechanics. | [SU1] Assessment of task fulfilment |
| K6_W03 | Students use the following mathematical methods and concepts applied in physics: special functions, Green's function method, integral transform methods, phasor method. | [SW3] Assessment of knowledge contained in written work and projects |

<table>
<tr><td>Subject contents</td><td>Lecture and tutorials:<br><br>1. Gamma function<br>2. Orthogonal polynomials<br>2.1. Gram - Schmidt orthogonalization, Rodrigues formula, generating functions<br>2.2. Hermite polynomials, harmonic oscillator<br>2.3. Legendre polynomials, electric potential, associated Legendre functions, spherical harmonics<br>3. Bessel functions<br>3.1. Bessel equation, Bessel functions<br>3.2. Heat transfer in an infinite cylinder, circular membrane problem<br>3.3. Equations leading to the Bessel equation<br>3.4. Spherical Bessel functions<br>3.5. Applications of Bessel functions<br>4. Green's function method<br>4.1. 1-D problems<br>4.2. 3-D problems<br><br>5. Complex-valued function of a real variable and its applications (e.g. phasor method, the method of the complex representation of electrical quantities)<br>6. Integral transform methods<br>6.1. Fourier transform method<br>6.2. Laplace transform method</td></tr>
<tr><td>Prerequisites and co-requisites</td><td>basics of differential calculus and integral calculus</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>2 tests</td><td>42.0%</td><td>100.0%</td></tr></table></td></tr>
<tr><td>Recommended reading</td><td><table><tr><td>Basic literature</td><td>M. Abramowitz, I. A. Stegun, "Handbook of Mathematical Functions"<br>F. W. Byron, R. W. Fuller, "Mathematics of Classical and Quantum Physics"<br>H. W. Wyld, "Mathematical methods for physics"</td></tr><tr><td>Supplementary literature</td><td>Donald A. McQuarrie, Mathematical Methods for Scientists and Engineers, University Science Books, 2003</td></tr><tr><td>eResources addresses</td><td>Adresy na platformie eNauczanie:<br>Zastosowania metod matematycznych w fizyce i technice_2024/25 - Moodle ID: 42923<br>https://enauczanie.pg.edu.pl/moodle/course/view.php?id=42923</td></tr></table></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td>Apply the GramSchmidt orthonormalization method to the functions {x_n}, n=0,1,2,... on the interval [1; 1] with the weighting function rho(x)=1.<br>Find eigenvalues and normalized eigenfunctions of the 1D harmonic oscillator subjected to a constant external force F.<br>Prove that the spherical harmonics are the eigenfunctions of the square of the angular momentum operator.<br>Determine the general solution to the differential equation describing the motion of a pendulum which length is a linear function of time.<br><br>Calculate the sum of two currents i1(t)=3 cos (157 t + pi/4) and i2(t)= -4 cos (157 t - pi/4)</td></tr>
<tr><td>Work placement</td><td>Not applicable</td></tr>
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