GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

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 2021	Academic year of realisation of subject	2023/2024
Education level	first-cycle studies	Subject group	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	3	Language of instruction	Polish
Semester of study	6	ECTS credits	4.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Zakład Fizyki Atomowej, Molekularnej i Optycznej -> Instytut Fizyki i Informatyki Stosowanej -> 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:

1. Gamma function
2. Orthogonal polynomials
2.1. Gram - Schmidt orthogonalization, Rodrigues formula, generating functions
2.2. Hermite polynomials, harmonic oscillator
2.3. Legendre polynomials, electric potential, associated Legendre functions, spherical harmonics
3. Bessel functions
3.1. Bessel equation, Bessel functions
3.2. Heat transfer in an infinite cylinder, circular membrane problem
3.3. Equations leading to the Bessel equation
3.4. Spherical Bessel functions
3.5. Applications of Bessel functions
4. Green's function method
4.1. 1-D problems
4.2. 3-D problems

5. Complex-valued function of a real variable and its applications (e.g. phasor method, the method of the complex representation of electrical quantities)
6. Integral transform methods
6.1. Fourier transform method
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"
F. W. Byron, R. W. Fuller, "Mathematics of Classical and Quantum Physics"
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:
Zastosowania metod matematycznych w fizyce i technice 2023/24 - Moodle ID: 34687
https://enauczanie.pg.edu.pl/moodle/course/view.php?id=34687</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 (x)=1.
Find eigenvalues and normalized eigenfunctions of the 1D harmonic oscillator subjected to a constant external force F.
Prove that the spherical harmonics are the eigenfunctions of the square of the angular momentum operator.
Determine the general solution to the differential equation describing the motion of a pendulum which length is a linear function of time.

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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