University of Gdańsk

Subject card

Subject name and code	Equations of Mathematical Physics, PG_00165950		
Field of study	Physics		
Date of commencement of studies	October 2024	Academic year of realisation of subject	2024/2025
Education level	postgraduate studies	Subject group	Obligatory subject group in the field of study Optional subject group
Mode of study	full-time studies	Mode of delivery	at the university
Year of study	1	Language of instruction	Polish In the case where there is a foreign participant, the language of instruction will be English. Similarly, if the instructor is a foreigner, the language of instruction will also be English.
Semester of study	1	ECTS credits	6.0
Learning profile	academic	Assessment form	
Conducting unit			
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. Marcin Marciniak	
	Teachers	dr hab. Marcin Marciniak	

Lesson types							
	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	0.0	0.0	60

Subject objectives	
	Equations of mathematical physics are usually referred to as second-order linear differential equations. The aim of the subject is to present the fundamental concepts and theorems related to the equations of mathematical physics and their applications. An additional goal is to familiarize students with the mathematical methods used to analyze these equations and their solutions.

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[FIZMU2_U12] is able to use English in the field of physics, mathematics and computer science, in accordance with the requirements specified for level B2+ of the Common European Framework of Reference for Languages, to a degree that allows him/her to independently supplement his/her education and communicate with specialists in the same or related specialization	The student is able to communicate in English on the subject of differential equation theory.	[SU1] oral statement/conversation/ discussion
	[FIZMU2_U05] has the ability to synthesize methods and ideas from different areas of physics and other sciences; is able to see that even distant phenomena are described by similar models	The student is aware of the possibility of applying differential equations to model phenomena in physics, chemistry, and biology. The student is aware of the possibility of applying differential equations to model phenomena in physics, chemistry, and biology.	[SU8] observation of student's independent or team work
	[FIZMU2_K02] is aware of the conclusive role of experiment in the verification of physical theories; is aware of the scientific method in the accumulation of knowledge	The student understands that a model based on differential equations is valuable only when its predictions are supported by experimental results.	[SK4] test/exam - oral or written
	[FIZMU2_K05] understands the need to popularize knowledge of physics including the latest scientific and technological developments	The student: - is aware that many phenomena in the surrounding reality can be modeled using differential equations, - understands that increasing awareness of the mechanisms of the surrounding reality positively influences both civilizational development and spiritual growth.	[SK8] observation of student's independent or team work
	[FIZMU2_U06] is able to adapt knowledge and methodology of physics as well as applied experimental and theoretical methods to related scientific disciplines	The student is familiar with the applications of differential equations in social sciences, medical sciences, biology, and chemistry.	[SU4] test/exam - oral or written
	[FIZMU2_W06] has knowledge of current developments in physics, especially within his chosen specialty	The student is familiar with the applications and current state of knowledge regarding the following equations: Laplace's equation, Poisson's equation, the wave equation, the heat equation, and selected integral equations.	[SW4] test/exam - oral or written
	[FIZMU2_U11] is able to determine the directions of further improvement of knowledge and skills (including self-education) in the chosen specialty and beyond it	The student is able to independently develop a self-selected topic in the field of differential equations.	[SU1] oral statement/conversation/ discussion
	[FIZMU2_K01] knows the limits of his own knowledge and skills; can formulate questions precisely; understands the need for further education of himself and others	The student: - is able to engage in discussions about the theory of differential equations, - is able to identify parts of the lecture and exercises that are unclear to them.	[SK1] oral statement/conversation/ discussion
	[FIZMU2_U10] is able to popularize science within his specialty or related areas of physics	The student is able to explain in a simple and accessible way the properties of harmonic functions, solutions to the wave equation, and solutions to the heat equation.	[SU4] test/exam - oral or written

Subject contents	Ordinary linear differential equations of the second order, Sturm-Liouville systems, orthogonal polynomials. Classification of second-order linear partial differential equations. Cauchy problem for the wave equation, d'Alembert's, Poisson's, and Kirchhoff's formulas. Local dependence principle and Huygens' principle. Classical theory of boundary value problems for Laplace's and Poisson's equations. Green's function and the basics of potential theory. Reduced Cauchy problem and initial-boundary value problems for parabolic equations. Maximum principle. Energy methods and Fourier separation of variables method for selected second-order equations.
Prerequisites and co-requisites	The student has knowledge of mathematical analysis, linear algebra, and mathematical methods in physics at the level of undergraduate courses.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Test	51.0%	50.0%
Exam	51.0%	50.0%

Recommended reading

Basic literature	F. W. Byron, R. W. Fuller, Mathematics in classical and quantum physics, PWN 1973 A. V. Bitsadze, Equation of mathematical physics, Mir Publisher 1985 L. Hørmander, The analysis of linear partial differential operators I: Distribution theory and Fourier analysis, Springer-Verlag 2004
Supplementary literature	G. B. Arfken, H. J. Weber, F. E. Harris, Mathematical Methods for Physicists, A Comprehensive Guide, Elsevier 2013 Y. Pinchover, J. Rubinstein, An introduction to partial differential equations, Cambridge University Press 2005
eResources addresses	Adresy na platformie eNauczanie:

Example issues/ example questions/ tasks being completed	
Work placement	Not applicable

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