

1.	Field of study	Physics
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2025/2026 (winter term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time
7.	General information about the module	
Module name		Mathematical Methods in Physics
Module code		W4-FZ-NM-S2-1-22-15
Number of the ECTS credits		4
Language of instruction		English
Purpose and description of the content of education		<p>The lecture includes a coherent and uniform presentation of elements of the theory with justifications and many examples derived from physics and engineering within the following topics:</p> <ol style="list-style-type: none"> 1. Elements of distribution theory: basic concepts, differentiation of distribution, the Dirac delta, and related distributions, the principal value of the integral; operations on distributions; Sochocki formulas, the convolution of distributions and their Fourier transform. 2. Green's functions of differential operators: boundary issues, related to eigenvalue problem; examples coming from physics and engineering (e.g. Sturm Liouville systems). 3. Elements of Hilbert space theory: basic concepts and examples; orthonormal and Schauder bases; unitary and self-adjoint operators; spectra and eigenvalues; subtleties of the formalism of quantum theory. 4. Fourier series and their properties. 5. Integral transforms; Fourier and Laplace transform and their properties. 6. Elements of signal analysis. <p>The classes and seminars are devoted to solving selected examples and explaining theories in specific physical situations. Students participate in deriving and discussing some formulas and examples from lectures, as well as the discussions of the significance of the discussed formalisms in various physical problems.</p> <p>As part of the student's work the student:</p> <ol style="list-style-type: none"> 1. strives to consolidate acquired knowledge based on lecture notes and supplementary literature; 2. improves the mathematical skills necessary to solve physical problems; 3. tries to accomplish the tasks proposed by the lecturer. <p>The exam is compulsory.</p>
List of modules that must be completed before starting this module (if necessary)		not applicable

8. Learning outcomes of the module			
Code	Description	Learning outcomes of the programme	Level of competenc (scale 1-5)
E1	understanding the civilization meaning of differential and integral calculus and its role in physics	KF_U01 KF_W01	4 4
E2	acquiring a good theoretical and practical intuition related to mathematical analysis; is able to perform basic calculations	KF_U02 KF_W02	4 4
E3	understanding the meaning and can give examples of the physical application of differential equations in physics and technology	KF_U01 KF_U02	3 3
E4	ability to perform simple calculations in Hilbert spaces	KF_U03 KF_W05	3 3
E5	understanding the need to use the distribution theory tools in various branches of physics and engineering	KF_U03 KF_W05	3 3
E6	understanding the ideas underlying Fourier analysis and its applications in various fields of physics and engineering	KF_U03 KF_W05	3 3
E7	awareness of the need to develop mathematical formalism in order to better describe and understand the physical world	KF_W01	4

9. Methods of conducting classes		
Code	Category	Name (description)
a01	Lecture methods / expository methods	Formal lecture/ course-related lecture <i>a systematic course of study involving a synthetic presentation of an academic discipline; its implementation assumes a passive reception of the information provided</i>
a05	Lecture methods / expository methods	Explanation/clarification <i>explication involving the derivation of a predetermined theorem from other, already known ones, in the number of steps specified by the person teaching the course</i>
b07	Problem-solving methods	Activating methods: a case study <i>a comprehensive description of a phenomenon connected with the selected discipline; reflecting the reality, presenting the 'what', 'where' and 'how' of the phenomenon, i.e., all of its key aspects to be discussed in class; used as a reproduction, presentation, discussion or diagnosis of factors that shape the phenomenon or interact with it; an in-depth qualitative analysis and evaluation of a selected phenomenon</i>

10. Forms of teaching					
Code	Name	Number of hours	Assessment of the learning outcomes of the module	Learning outcomes of the module	Methods of conducting classes
FZ1	lecture	30	exam	E1, E3	a01
FZ2	discussion classes	30	course work	E2, E4, E5, E6, E7	a05, b07

11. The student's work, apart from participation in classes, includes in particular:				
Code	Category	Name (description)		Is it part of the BUNA?
a02	Preparation for classes	Literature reading / analysis of source materials <i>reading the literature indicated in the syllabus; reviewing, organizing, analyzing and selecting source materials to be used in class</i>		No
a03	Preparation for classes	Developing practical skills <i>activities involving the repetition, refinement and consolidation of practical skills, including those developed during previous classes or new skills necessary for the implementation of subsequent elements of the curriculum (as preparation for class participation)</i>		Yes
b01	Consulting the curriculum and the organization of classes	Getting acquainted with the syllabus content <i>reading through the syllabus and getting acquainted with its content</i>		No
c02	Preparation for verification of learning outcomes	Studying the literature used in and the materials produced in class <i>exploring the studied content, inquiring, considering, assimilating, interpreting it, or organizing knowledge obtained from the literature, documentation, instructions, scenarios, etc., used in class as well as from the notes or other materials/artifacts made in class</i>		Yes
c03	Preparation for verification of learning outcomes	Implementation of an individual or group assignment necessary for course/phase/ examination completion <i>a set of activities aimed at performing an assigned task, to be executed out of class, as an obligatory phase/element of the verification of the learning outcomes assigned to the course</i>		Yes
d01	Consulting the results of the verification of learning outcomes	Analysis of the corrective feedback provided by the academic teacher on the results of the verification of learning outcomes <i>reading through the academic teacher's comments, assessments and opinions on the implementation of the task aimed at checking the level of the achieved learning outcomes</i>		No

Information on the details of the module implementation in a given academic year can be found in the syllabus available in the USOS system: <https://usosweb.us.edu.pl>.