UCLouvain

lphys1202

2020

Mathematical methods for physics

Due to the COVID-19 crisis, the information below is subject to change, in particular that concerning the teaching mode (presential, distance or in a comodal or hybrid format).

5 credits	30.0 h + 30.0 h	Q1

Teacher(s)	Degrande Céline ;Hagendorf Christian ;
Language :	French
Place of the course	Louvain-la-Neuve
Prerequisites	*The prerequisite(s) for this Teaching Unit (Unité d'enseignement – UE) for the programmes/courses that offer this Teaching Unit are specified at the end of this sheet.*
Main themes	The purpose of this teachingunit is to familiarize the student with the mathematical tools and methods ofquantum physics. The covered topics are elements of theory of the classical linear partial differential equation theory of physics (heat equation, wave equation and Laplace equation), Fourier series andtheFourier transformation, elements of the theory of Hilbert spaces and orthogonal polynomials over finite and infinite intervals.
Aims	**a. Contribution the teaching unit to the learning outcomes of the programme** 1.1, 1.3, 1.4, 2.1, 3.1, 3.2, 3.3, 3.4, 3.5, 3.6 **b. Specific learning outcomes of the teaching unit** At the end of this teaching unit, the student will be able to : 1 ' find the solutions of the classical partial differential equations of physics in simple geometries; ' determine the Fourier series of a given function; ' apply the abstract theory of Fourier series in Hilbert spaces; ' construct the classical orthogonal polynomials and apply them to the solution of differential equations; ' apply the Fourier transform to solve partial differential equations. - - - - *The contribution of this Teaching Unit to the development and command of the skills and learning outcomes of the programme(s) can be accessed at the end of this sheet, in the section entitled "Programmes/courses offering this Teaching Unit".*
Evaluation methods	**Due to the COVID-19 crisis, the information in this section is particularly likely to change.** The evaluation is based on a written exam and a continuous assessment during the semester. The exam deals with the application of calculation techniques of mathematical methods of physics. It tests the student's knowledge and his understanding of the notions seen in the theoretical course, the mastery of calculation techniques and the coherent presentation of this analysis. The result of the continuous assessment will be used for each session and cannot be represented. The evaluation methods may be adapted and modified according to the evolution of the Covid-19 pandemic.
Teaching methods	**Due to the COVID-19 crisis, the information in this section is particularly likely to change.** The learning activities consist of lectures and exercise sessions. The lectures introduce the concepts and ideas of mathematical methods that are necessary for understanding modern physics (such as quantum physics), establish rigorous results and present computational techniques and strategies. Furthermore, the connection with other teaching units of the Bachelor's programme in physics is emphasised. The main objective of the exercise sessions is the application of the theory to concrete examples.
Content	1. **Fourier series:** periodic functions, trigonometric polynomials, Fourier series, Bessel's inequality, Parseval's theorem, convergence and Dirichlet's theorem, applications. 2. **Partial differential equations:** classification of linear partial differential equations of second order, heat equation, wave equation, Laplace equation, existence and uniqueness of solutions, solution methods. 3. **Hilbert spaces:** pre-Hilbert spaces, completeness and Hilbert spaces, Hilbert bases, examples (sequence and function spaces), abstract theory of Fourier series. 4. **Orthogonal polynomials:** definition on finite and infinite intervals, recurrence relations, Rodriguez' formula and the classical orthogonal polynomials (Jacobi, Chebyshev, Legendre, Laguerre, Hermite), second-order differential equations, application of Legendre polynomials and spherical harmonics in physics. 5. **The Fourier transformation:** definition and properties, convolution product, Poisson summation formula, applications to the solution of linear differential equations, distributions and their Fourier transformation.

Inline resources	The MoodleUCL website of this teaching unit contains a detailed plan of the covered topics, a complete bibliography, exercise sheets and a collection of exam subjects from past years.
Bibliography	• W. Appel "Mathématiques pour la physique et les physiciens", Éditions H & K, Paris (2008). • C. Aslangul "Des mathématiques pour les sciences", De Boeck (2011).
Faculty or entity in charge	PHYS

Programmes containing this learning unit (UE)				
Program title	Acronym	Credits	Prerequisite	Aims
Bachelor in Physics	PHYS1BA	5	LMAT1121	🔍