Study program	Level of studies	**First cycle**
	Study program name	**Physics Education**
Course name	**MATHEMATICAL METHODS OF PHYSICS II FOR TEACHERS**	

Course ID	Semester	Course status	ECTS credits	L+E
PCS4712	**IV**	**MANDATORY**	**6**	**3+3**

Lecturer	
Aims and intended learning outcomes	Aim of this course is to familiarize students with a range of mathematical methods that are essential for solving advanced problems in theoretical physics. After successfully completed course, a student will be able to use complex analysis in solving physical problems; use Fourier series and Fourier transformation in physical problems; use Green functions; solve Sturm-Liouvill's problem and partial differential equations of second order that are common in the physical sciences; use the orthogonal polynomials and specific special functions in physical problems; use the calculus of variations.

Course content

Complex algebra; complex functions; Cauchy-Riemann conditions; line integral; Cauchy's integral theorem; Cauchy's integral formula and its applications; Complex function series; Uniform convergence. Taylor expansion; analytic extension; poles of the function; determination of residues; Laurent development; mapping; cut line, branch point and multi-valued functions; conformal mapping; singularities; Residue Theorem; Cauchy principal value; Jordan's lemma. Dispersion relations. Euler's functions (Beta and Gamma). Fourier transformation and uncertainty principle. Dirac delta function; Sine and cosine transformations. Convolution theorem. Parseval's theorem.

Fourier series. Dirichlet conditions. Spectroscopy. Partial differential equations and physical problems: Laplace eq., Poisson's eq., wave eq. e.t.c. General solution for PDE. Separation of variables; Regular S-L problem; self-adjoint differential equations; hermitian operators, Gram-Schmidt orthogonalization process; orthogonal polynomials; completeness of the eigenfunctions; Bessel's inequality. Green's function, expansion of Green's functions; Green's function for LHO. Schrodinger equation for hydrogen atom: Legendre polynomials; associated Legendre polynomials; Spherical function; Multiple moments; Laguerre polynomials; associated Laguerre polynomials; Quantum mechanics LHO: Hermite polynomials; Bessel functions; QM scattering and spherical Bessel functions; Calculus of variations; Functionals; Euler-Lagrange equation.

Student workload (hours)		Grading	
Lectures and Exercises	90	Assessment method	Points
Exam preparation	60	Midterm exams	55
Total	150	Final exam	45
		Total	100

Literature

1. M. Boas, Mathematical methods in the physical sciences, third edition, Wiley 2006
2. Corresponding material from the web-site "e-nastava" and notes from the lectures

Additional readings:

1. K. F. Riley, M. P. Hobson, S. J. Bence, Mathematical methods for physics and engineering, 3rd edition, Cambridge University Press
2. G. Arfken, H. Weber, Mathematical methods for physicists, Elsevier 2005

Remarks

The final exam is oral when possible. Students must score a minimum of 55% of the tests in order to enter the final exam. In order to successfully pass at the final exam, the student must score at least 50% of the points, with the total score at least 55 points.