Study program	Level of studies	**Third cycle**		
	Title of the study program	**Doctoral studies in physics**		
Course title	**ADVANCED QUANTUM FIELD THEORY**			
Course ID	Semester	Course status	ECTS credits	Teaching hours
PTH8011	**I /II**	**Mandatory/Elective**	**10**	**30**
Course aims and expected learning outcomes	- Mastery of the mathematical tools required for exploring quantum field theory. - Understanding of infrared and ultraviolet divergences. - Familiarization with methods of renormalization for theories with spontaneously broken symmetries of Abel and Yang-Mills type. - Acquisition of the mathematical apparatus necessary for studying processes within the standard model of elementary particle physics and its extensions.			

COURSE CONTENT

Radiative corrections in quantum field theory. Examples of infrared and ultraviolet divergences in quantum electrodynamics. Classification of operators and their level of divergence in quantum field theory. Introduction of mathematical apparatus related to the calculation of divergent integrals. Ward-Takahashi identities in quantum electrodynamics. Renormalization of perturbative theories. Renormalization of theories with spontaneous breaking of local Abelian symmetry. Study of renormalization group equations. Calculation of the Coleman-Weinberg potential. Calculation of higher (second) order radiative corrections. Example of a Yang-Mills type theory: quantum chromodynamics. Higgs mechanism. Massive vector fields. Anomalies in quantum theories with spontaneously broken Yang-Mills symmetry. Renormalization of theories with spontaneously broken non-Abelian symmetries. Magnetic monopoles. Unification of interactions and associated coupling constants present in the standard model of elementary particle physics.

LITERATURE	ASSESSMENT OF LEARNING	
- Matthew D. Schwartz, *Quantum Field Theory and the Standard Model*, Cambridge University Press, 2014 - Michael E. Peskin, Dan V. Schroeder, *An Introduction To Quantum Field Theory* (Frontiers in Physics), Westview Press, Reprint edition (October 2, 1995). - A. Zee, *Quantum Field Theory in a Nutshell*, Princeton University Press, 2 edition (February 1, 2010). - Claude Itzykson, Jean-Bernard Zuber, *Quantum Field Theory* (Dover Books on Physics), Dover Publications (February 24, 2006).	Assessment Method	Points
	Homework	30%
	Seminar paper	30%
	Final exam	40%
	Total	100

Remarks