DOCTORAL STUDIES COURSE UNIT DESCRIPTION

Name of subject	Scientific Field	Faculty	Center/Institute/ Department
Quantum Field Theory (8 ECTS credits)	Physics N 002	Faculty of Physics	Institute of Theoretical Physics and Astronomy
Student's workload	Hours	Student's workload	Hours
Lectures		Consultations	30
Individual study	160	Seminars	10

Course annotation
Basics of Field Theory (History and Introduction, Lorentz invariance and second quantization, Classical field theory, Old-fashioned perturbation theory, Cross sections and decay rates, The S-matrix and time-ordered products, Feynman rules); *Quantum electrodynamics* (Spin 1 and gauge invariance, Scalar QED, Spinors, Spinor solutions and CPT, Spin and statistics, QED, Path integrals); *Renormalization* (introductory examples, Vacuum polarization, Mass renormalization, Renormalized perturbation theory [i.e. Counterterms, Two-point functions, Three-point functions, Renormalization conditions in QED], Infrared divergences, Renormalizability, Non-renormalizable theories, The renormalization group, Implications of unitarity); *The Standard Model* (Yang–Mills theory and Quantum Yang–Mills theory, Gluon scattering and the spinor-helicity formalism {if student is interested and time permits}, Spontaneous symmetry breaking, Weak interactions, Anomalies, Precision tests of the Standard Model, Quantum chromodynamics and the parton model); *Advanced topics* {if student is interested and time permits} (Effective actions and Schwinger proper time, Background fields, Heavy-quark physics, Jets and effective field theory),
List of literature
1. Matthew D. Schwartz, "Quantum Field Theory and the Standard Model", Cambridge University Press; ISBN 9781107034730 (2014).
List of additional literature
1. A. Zee, "Quantum Field Theory in a Nutshell", Princeton University Press; ISBN 0-691-01019-6 (2003). 2. Michael E. Peskin and Daniel V. Schroeder, "An Introduction to Quantum Field Theory", Reading, USA: Addison-Wesley; ISBN 0-201-50397-2 (1995). 3. David Tong, "Lectures on Quantum Field Theory", http://www.damtp.cam.ac.uk/user/tong/qft/qft.pdf (2006). 4. I. J. R. Aitchison and A. J. G. Hey, "Gauge theories in particle physics: A practical introduction. Vol. 1: From relativistic quantum mechanics to QED", Bristol, UK: CRC Press; ISBN 9781466512993 (2012). 5. I. J. R. Aitchison and A. J. G. Hey, "Gauge theories in particle physics: A practical introduction. Vol. 2: Non-Abelian gauge theories: QCD and the electroweak theory", Bristol, UK: CRC Press; ISBN 9781466513075 (2012). 6. Steven Weinberg, "The Quantum Theory of Fields, I and II", Cambridge University Press; ISBN 0-521-58555-4 (1995).

The names of consulting teachers	Science degree	Pedagogical name	Main scientific works published in a scientific field in last 5 year period
Thomas Gajdosik	Dr.	Doc.	1. T. Gajdosik, A. Juodagalvis, D. Jurčiukonis, and T. Sabonis, *Constraints on the Higgs Sector from Radiative Mass Generation of Neutrinos,* Acta Phys. Polon. B 46 (2015) 11, 2323. doi:10.5506/AphysPolB.46.2323 2. V. Dūdėnas and T. Gajdosik, *Feynman Rules for Weyl Spinors with Mixed Dirac and Majorana Mass Terms,* Lith. J. Phys. 56, 149–163 (2016). doi:10.3952/physics.v56i3.3364 3. V. Dūdėnas, T. Gajdosik, A. Juodagalvis, D. Jurčiukonis, *The One-loop Improved Lagrangian of the Grimus-Neufeld Model*, Acta Phys. Polon. B 48 (2017) 2235. doi:10.5506/APhysPolB.48.2235 4. V. Dūdėnas and T. Gajdosik, *On the Renormalization of Neutrinos in the Seesaw Extension of the Two-Higgs Doublet Model,* Acta Phys. Polon. B 48 (2017) 2243. doi:10.5506/APhysPolB.48.2243 5. V. Dūdėnas and T. Gajdosik, *Gauge dependence of tadpole and mass renormalization for a seesaw extended 2HDM*, Phys. Rev. D 98 (2018) no.3, 035034 doi:10.1103/PhysRevD.98.035034 [arXiv:1806.04675 [hep-ph]]. 6. D. Jurčiukonis, T. Gajdosik and A. Juodagalvis, *Seesaw neutrinos with one right-handed singlet field and a second Higgs doublet*, JHEP 911 (2019) 146; doi:10.1007/JHEP11(2019)146 [arXiv:1909.00752 [hep-ph]]. 7. S. Draukšas, V. Dūdėnas, T. Gajdosik, A. Juodagalvis, P. Juodsnukis, and D. Jurčiukonis, *The Grimus–Neufeld Model with FlexibleSUSY at One-Loop,* Symmetry 11 (2019) no.11, 1418. doi:10.3390/sym1111141
Certified during Doctoral Committee session 02/02/2022, protocol No. (7.17 E) 15600-KT-32			
Committee Chairman prof. S. Juršėnas			