Level: master

Course title: Introduction to Quantum Field Theory

Status: elective

**ECTS**: 9

**Requirements**: Basis of Mathematical Physics, Mathematical Physics, Introduction to Theoretical Physics, Modern theoretical physics, Quantum physics

## Learning objectives

Acquiring knowledge of Lagrange formalism, canonical quantization and symmetry theory in order to develop perturbation theory of interacting fields. Application of Feynman diagram technique to calculation of different processes in second order perturbation theory.

## Learning outcomes

After taking the course, the student should have developed:

**General abilities**: basic knowledge of this field, following the literature, analysis of various solutions and the choice of the most adequate solution, application in practice and other subjects. **Subject-specific abilities:** 

Student will acquire the knowledge of the basic methods and results in the contemporary quantum field theory and learn to apply the technique of Feynman diagrams.

## Syllabus

Theoretical instruction

Classical theory of free fields: particles and fields. Lagrange formalism. Symmetries and conservation laws (Noether's theorem). Scalar and vector field. Electromagnetic field. Spinor field.

Quantum theory of free fields: Canonical quantization. Types of commutation relations. Relation between spin and statistics (Pauli's theorem). Integer-spin fields. Spinor filed. Discrete symmetries (CPT theorem).

Theory of interacting fields: interaction Lagrangian. Gauge fields. Scattering matrix. Perturbation theory. Wick's theorem. Feynman's diagrams. Examples of the second-order processes. Ultraviolet divergences in higher order perturbation theory.

*Practical instruction* Exercises.

| Weekly teaching load |            |                |                   | Other: |
|----------------------|------------|----------------|-------------------|--------|
| Lectures:            | Exercises: | Other forms of | Student research: |        |
| 3                    | 1          | teaching: 1    |                   |        |