Basic Information:
Course Title: Quantum Field Theory
Lecturer: Nikolay M. Nikolov
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Total Teaching Hours: 45

Annotation (up to 150 words)
The course aims to make an introduction to one of the most modern and fundamental areas of contemporary physics and related mathematical concepts. Quantum Field Theory is still a mathematically incomplete theory. Moreover, as one of the "millennium problems", along with Riemann's hypothesis, the task of the complete mathematical construction of one of the basic models of Quantum Field Theory is the non-Abelian Yang-Mills Theory. At the same time, the Quantum Field Theory is one of the mathematically richest fields in physics and is the generator of many ideas in modern mathematics. This course does not require prior knowledge of physics or mechanics. The main phenomenological foundations of Quantum Field Theory will be introduced. The formalism of perturbation theory is scattering theory will be developed. Fock's space formalism and second quantization will be presented. Exact mathematical formulations will be given wherever it is possible. Due to the great variety of mathematical methods used, not all results will be possible to prove, but one of the main purposes of the course is to give students accurate references to the mathematical disciplines that are used. It is assumed that the students have basic knowledge in the courses in Mathematical Analysis and Algebra. The course is structured so that it is accessible both to students of mathematical specialties without prior knowledge in Quantum Physics, and to physicists to whom it will be presented an accurate mathematical formulation of the physical principles.

Course content (brief description by topics or modules)
Module 1: Fundamental Principles and Scattering Theory
Module 2: Perturbation Theory and Feynman Diagrams
Module 3: Models of Quantum Field Theory

Teaching and assessment methods
Lectures and presentations.
Written and oral examination.

Competencies acquired as a result of training (3–5 points)

1. Understanding of the fundamental principles of quantum theory.
2. Knowledge of scattering theory in quantum theory.
3. Ability to use and interpret Feynman diagrams.
4. Knowledge of the basic models of quantum field theory.

Literature:

1. Itzykson, C., Zuber, J.-B. Quantum Field Theory. New York: McGraw-Hill, 1980
2. Michael E. Peskin; Daniel V. Schroeder. An Introduction to Quantum Field Theory. Boca Raton, FL: CRC Press, 2018
3. Bogoliubov, N. N.; Shirkov, D. V. Introduction to the Theory of Quantized Fields. 3rd ed. New York: John Wiley & Sons, 1980
4. Bogoliubov, N. N.; Logunov, A. A.; Oksak, A. I.; Todorov, I. T. General Principles of Quantum Field Theory. Dordrecht: Kluwer Academic Publishers, 1990
5. Streater, R. F.; Wightman, A. S. PCT, Spin and Statistics, and All That. Princeton, NJ: Princeton University Press, 2000
6. Jost, Res. The General Theory of Quantized Fields. Providence, RI: American Mathematical Society, 1965
7. Haag, Rudolf. Local Quantum Physics: Fields, Particles, Algebras. 2nd ed. Berlin; Heidelberg: Springer-Verlag, 1996

Additional information (optional) (e.g., special requirements, laboratory equipment, prior knowledge)

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