01.07.2019

Bar-Ilan University

Advanced Quantum Theory

86-803-01

Lecturer: Prof. Efrat Shimshoni
Course type: Lecture + tutorial
Date: 2019-2020 **semester:** A **weekly hours:** 2L+2P

Aim of course:

Transforming from particles to fields. Quantization of the electromagnetic field. Systems of identical particles: second quantization of bosons and fermions. Symmetry and conservation laws. Formulation of Quantum Theory using Path Integral formalism. Coherent states and their applications in quantum field theory. Interaction of radiation with matter. Approximation methods for interacting systems: Hartree-Fock, Thomas-Fermi, BCS theory for superconductivity. Relativistic quantum mechanics - spin-zero-particle: the Klein-Gordon equation. A spin-1/2 particle: the Dirac equation.

Details of subjects to be covered:

- Quantization of fields, quantum electrodynamics, interaction between electrons and electromagnetic field.
- Path integrals formulation of single particle quantum mechanics, and coherent states path integrals of many-body systems
- Superfluidity and superconductivity, Bose-Einstein condensation, high-temperature superconductivity.
- Relativistic quantum mechanics, Dirac theory
- Green function, Feynman diagrams.
- Quantum versus classic mechanics, WKB and other approximations.

Course mandatories:

Assignments: Homework and final exam.

Grading:

80% exam, 20% homework.

Bibliography:

A. Altland and B. Simons, "Condensed Matter Field Theory".
Tom Lancaster and S. J. Blundell, "Quantum Field Theory for the Gifted Amateur".