

PHYSICS 341, SOLID STATE PHYSICS

Spring 2021

Instructor: Valeri Kotov

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Lectures: Tuesdays and Thursdays, 4:25 pm - 5:40 pm, INNOV E105

Office hours: Fridays 1:00 pm - 3:00 pm, via TEAMS, or by appointment

Textbook: “Many-Body Quantum Theory in Condensed Matter Physics: An Introduction,” by H. Bruus and K. Flensberg, Oxford University Press, 2004.
ISBN 0198566336

Other Books: I also use very frequently the following two books:

Mahan, G., “Many-Particle Physics”, any edition

Ashcroft, N.W., and Mermin, N.D., “Solid State Physics”, any edition

Prerequisites: Knowledge of Quantum Mechanics as well as basic Statistical (Thermal) physics is required.

Even though some knowledge of solid state at the lower level (Intro to Solid State, PHYS 242) is desirable, it is not required. The basic concepts will be introduced when necessary.

General Course Description: This course is designed as an introduction to advanced concepts and techniques used in Solid State Physics, suitable for both experimentalists and theorists at the upper undergraduate and graduate level. We will discuss such techniques as second quantization, Green's functions, mean-field theory, etc., as well as the physical phenomena where they are most frequently applied. I plan to cover:

- Second Quantization
- The Electron Gas
- Phonons and electron-phonon interactions
- Mean-Field Theory with applications
- Linear Response Theory
- Green's Functions with applications
- Feynman Diagrams
- Interacting Electrons and Fermi Liquid Theory
- Superconductivity

Homework/Exams/Grades: Homework will be assigned on a regular basis. There will be one midterm and a final exam, possibly take home and/or in the form of projects. Grades will be based on the homework (roughly 50%), and exams/projects (50%).