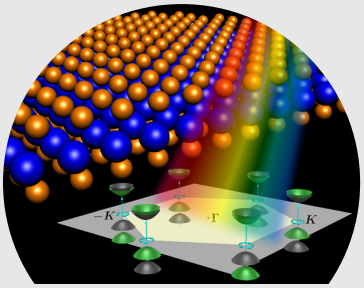

CMP: Phys 473

Senior of the course:
Dr. Abdelhamid Galal.

Lectures will be provided by
Dr. Majed Nashaat

Instructor Info

Dr. Abdelhamid Galal. Room
Dr. M. Nashaat. Room:B303

Physics Department.

aagalal@aucegypt.edu.
majed@sci.cu.edu.eg

Course Info

Prereq: Student may revise basic definisions in solid state physics by Giuseppe Grosso and Giuseppe Pastori Parravicini (from page 38 to 61). These topics have been covered in solid state course.

Date: Thursday.

Time: From 12:00 to 2:00 p.m.

Lecture Room no: 25

Overview

Condensed matter physics is a big subject. Therefore, I will try to cover as many topics as possible. The elementary topics, such as crystal structure, already have been covered in solid state course. This course is divided into two parts. In the first part, we will work on the electronic structure of the crystal. In the second part, we will consider several topics in condensed matter physics and we will learn how to get the energy spectrum from Hamiltonian using 2^{nd} quantization quantum mechanics.

Material

Required Texts

Condensed Matter Physics 2^{nd} Edition by Michael P. Marder.
Solid state physics by Giuseppe Grosso and Giuseppe Pastori Parravicini.

Recommended Texts

Modern Condensed Matter Physics by Steven M. Girvin, Kun Yang (2019). (I will provide specific chapters of it during the lectures).
Solid State Basics by Steven Simons, author lecture can be found here "https://podcasts.ox.ac.uk/series/oxford-solid-state-basics".

Lecture notes

After each lecture the notes will be published on the same day with homework on the faculty web-page or in https://scholar.cu.edu.eg/?q=majed/classes/introduction-condensed-matter-physics.

Grading Scheme

20 degrees	Student participation / Homework
20 degrees	Midterm Exams
60 degrees	Final Exam

Grades follow the standard scale according to the faculty regulations.

Final Exam Scheme

The final exam will follow the faculty instructions:

60%	Related to the main course topic.
20%	Related to the homework topics.
20%	Completely new problems, the student should apply what she / he learned during the course to solve it.

Calculator will not be allowed in the midterm/ final exam. No derivation questions of models, which will be studied in the course, will be included in the exam (but the mathematical methods may be needed to solve the exam problem).

Learning Objectives

- Students will learn and improve their knowledge of the basic concepts in condensed matter physics.
- Learn how to find the band structure for electrons in the crytsal.
- Learn how to apply "2^{nd} quantization quantum mechanics to find the energy spectrum of the elementary excitations in several condensed matter systems.
- Gain some skills regarding the strategy to solve problems related to condensed matter physics.
- Gain some skills regarding how to handle specific topic and represent it.

FAQs

Do we dissect real fish in this course?

Yes, we do actually dissect fish. If you know of any issues that may cause you difficulties during dissections, please notify your TA ASAP.

What is a fish?

No clue. When someone says ‘fish’, we have a picture of a general fish of a general shape in our minds, but the truth is that ‘fish’ doesn’t have scientific meaning. Here’s a funny video about that: Youtube (hyperlink).

What is your favorite fish?

A lumpsucker. They are incredibly, adorably weird-looking.

What’s the difference between plural ‘fish’ and ‘fishes’?

‘Fish’ is the plural form when talking about two or more fish of the same species. ‘Fishes’ is the plural when talking about two or more different species.

Course Syllabus

- Basic concepts in condensed matter and 2^{nd} quantization qunatum mechanics.
- Part One: Electronic structure of crystal
  - Free and quasi electron model.
  - Bloch theory and plane wave method.
  - Tight binding method.
  - Application of band theory.
  - Electron in metal (Jellium model).
- Part Two: Elementary excitation spectrum
  - Phonon and crystal vibration.
  - Spin wave in magnetic system.
  - Bogoliubov excitation in Bose condensation.
  - Microscopic theory for superconductors.

Course Material Download Link

- Condensed Matter Physics 2^{nd} Edition by Michael P. Marder, can be downloaded from "Wiley Online Library" https://onlinelibrary.wiley.com/doi/book/10.1002/9780470949955.

- Solid state physics by Giuseppe Grosso and Giuseppe Pastori Parravicini, can be downloaded from web.

Lectures Schedule

Part 1:

Week 1	Basic concepts in condensed matter, 2^{nd} quantization qunatum mechanics.	Lec. Ref: Lecture note. Fundamentals of Condensed Matter Physics by Marvin L. Cohen and Steven G. Louie.
Week 2	Free and quasi electron model.	Lec. Ref: Lecture note handouts. lectures given by Prof.Sandro Scandolo. TextBooks: Solid state physics by Giuseppe Grosso and Giuseppe Pastori Parravicini. & Condensed Matter Physics 2^{nd} Edition by Michael P. Marder
Week 3	Bloch theory and plane wave method.	Lec. Ref: Lecture note handouts. lectures given by Prof.Sandro Scandolo. TextBooks: Solid state physics by Giuseppe Grosso and Giuseppe Pastori Parravicini. & Condensed Matter Physics 2^{nd} Edition by Michael P. Marder
Week 4	Bloch theory and plane wave method, cont. Solve problems	Lec. Ref: Lecture note handouts. lectures given by Prof.Sandro Scandolo. TextBooks: Solid state physics by Giuseppe Grosso and Giuseppe Pastori Parravicini. & Condensed Matter Physics 2^{nd} Edition by Michael P. Marder.
Week 5	Tight binding method.	Lec. Ref: Lecture note handouts. lectures given by Prof. Nadia Binggeli.

		TextBooks: Solid state physics by Giuseppe Grosso and Giuseppe Pastori Parravicini. & Condensed Matter Physics 2^{nd} Edition by Michael P. Marder.
Week 6	Application of band theory .	Lec. Ref: Lecture note handouts.
Week 7	Electron in metal (Jellium model).	Lec. Ref: Lecture note handouts. TextBooks: Solid State Basics by Steven Simons .

Part Two:

Week 8	Phonon and crystal vibration.	Lec. Ref: Lecture note handouts.
Week 9	Bogoliubov excitation in Bose condensation.	Lec. Ref: Lecture note handouts.
Week 10	Bogoliubov excitation in Bose condensation cont'.	Lec. Ref: Lecture note handouts.