COURSE OUTLINE
PHYS 482– Spring 2023

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COURSE OBJECTIVES

The main course objectives are to introduce students valuable theoretical introduction and an overview of the fundamental applications of the physics of solids. Students will be exposed to the standard approximations, models & methods of Solid State Physics (Condensed Matter Physics, Materials Physics) and to the common features in the physics of crystalline materials. This course covers fundamentals of solid state physics, where electron theory as the basics of materials science is mainly discussed. The course teaches the electronic band theory from the basics which describe the electronic states of solids. The "nearly free-electron model" and the "tight-binding approximation" will be introduced as the simplest and most valuable models in the band theory. This course includes theoretical description of crystal and electronic structure, lattice dynamics, and optical properties of different materials (metals, semiconductors, dielectrics, magnetic materials and superconductors), based on the classical and quantum physics principles.

LEARNING OUTCOMES

This course deals with crystalline solids and is intended to provide students with basic physical concepts and mathematical tools used to describe solids. The course deals with groups of materials in terms of their structure, electronic, optical, and thermal properties. Upon completion of this course, the student will be able to:

1 Model electrical & energy transport at several levels of mathematical sophistication.
2. Examine the properties of semiconductor materials, and the doping requirements for their use in electronics.
3. Explore the optical properties of solids & the optical characterization of electronic excitations.
4. Encounter special material properties such as superconductivity, magnetism, piezo-electricity, etc.
5. Apply physics principles to solve problems and explain experimental physics applications.
6. Develop the ability to appraise, use, and interpret experimental laboratory data collected to Correctly solve and/or explain the physical phenomena observed.

Prerequisites

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Course Materials:

1. Charles Kittel, Introduction to Solid State Physics, Wiley; 8th edition
2. Neil W. Ashcroft and N. David Mermin, Solid State Physics; 1st edition
3. M.Ali Omar, Elementary solid state physics, 5th edition.

Course grading: Your final grade will be based on the following:

Assignments + Quizzes + Class Participation + Presentation	50%
Midterm Test	25%
Final Examination	25%
	100%

Syllabus and Tentative schedule:

Week	Learning Activity
1-2	Free electron theory of metals and Fermi statistics
3	Band theory of solids
4	Band structure
5	Electron statistics and electron statistics
6	Electron Carrier concentration and transport:
7	Conductivity and mobility
8	Magnetic field Effects: Cyclotron resonance and Hall effect
9	Optical properties; absorption, photoconductivity and luminescence
10	Metals, insulators and semiconductors
11	Dielectric properties of solids
12	Classification of magnetic materials
13	Magnetism in metals, Magnetic resonance
14	Superconductivity