



SYLLABUS

Course Code	Course Num.	Course Name	Credit Hours	Lec.	Lab.	Tut.	Private study	Pre-requisites	Course Level	Language
PHY	461	Solid State Physics	4	3	0	2	6	PHY 312	7	English

A. Course Description

This course integrates theory of solid state physics with experimental demonstrations in the research Physics Lab. The course will provide a valuable theoretical introduction and an overview of the fundamental applications of the physics of solids. 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, diamagnetism and paramagnetism, ferromagnetism and antiferromagnetism), based on the classical and quantum physics principles.

B. Course Outcomes

At the end of this course the student will be able to:

1. Understand basic physical concepts and mathematical tools used to describe solids.
2. Develop knowledge and understanding the fundamental applications of the physics of solid.
3. Describe the theoretical description of crystal and electronic structure, lattice dynamics, and optical properties of different materials.
4. Learn the techniques to solve, through discussion and reading, a wide range of specific theoretical problems including their backgrounds and implications.

C. References

Required Textbook

Kittel C., *Introduction to Solid State Physics*, 8th Edition, John Wiley & Sons, NY (2004).

Other references

Ashcroft N.W. and Mermin N.D., *Solid State Physics*, Rinehart and Winston, NY (1976).

Course Website: <http://www.imamm.org/>

D. Topics Outline

1. **Crystal Structure:** Periodic array of atoms; fundamental types of lattices; index systems for crystal planes, simple crystal structures; direct imaging of atomic structure; non-ideal crystal structures (Contact hours: 10).
2. **Wave Diffraction and the Reciprocal Lattices:** Diffraction of waves by crystals; scattered wave amplitude; Brillouin zones; Fourier analysis of the basis (Contact hours: 10).
3. **Binding in Crystals:** Basic types of binding, examples (Contact hours: 5).
4. **Phonons-Crystal Vibrations:** Vibrations of crystals with monoatomic basis; two atoms per primitive basis; quantization of elastic waves; phonon momentum; inelastic scattering by phonons (Contact hours: 10).
5. **Phonons-Thermal Properties:** Phonon, heat capacity; anharmonic crystal interactions; thermal conductivity (Contact hours: 10).



6. **Free electron Fermi gas:** Energy level in One dimension, effect of temperature on the Fermi-Dirac distribution, free electron gas in three dimensions, heat capacity of the electron gas, electrical conductivity and Ohm's law (Contact hours: 10).
7. **Semiconductor crystals:** Band Gap, equations of motion, intrinsic carrier concentration, impurity conductivity and thermoelectric effects (Contact hours: 10).
8. **Introduction to superconductivity** (Contact hours: 5).
9. **Introduction to magnetism:** Diamagnetism, paramagnetism, ferromagnetism and antiferromagnetism (Contact hours: 5).

E. Office Hours

Office hours give students the opportunity to ask in-depth questions and to explore points of confusion or interest that cannot be fully addressed in class.

F. Exams & Grading System

The semi-official dates of the exams for this course are:

- **Midterm 1:** 6th or 7th week.
- **Midterm 2:** 11th or 12th week.
- **Quizzes & Homeworks:** During the semester.
- **Final Exam:** 16th week.

Your course grade will be based on your semester work as follows:

Midterm 1: 20 %	Midterm 2: 20 %	Final Exam: 40 %
Quizzes, Homework, Attendance & Participation: 20 %		

The grading distribution:

A ⁺	A	B ⁺	B	C ⁺	C	D ⁺	D	F
[95, 100]	[90, 95]	[85, 90]	[80, 85]	[75, 80]	[70, 75]	[65, 70]	[60, 65]	[0, 60]

G. Student Attendance/Absence

Only three situations will be considered as possible excused absences:

- Occurrence of a birth or death in the immediate family will be excused. ("Immediate family" is defined by the University as spouse, grandparents, parents, brother, or sister).
- Severe illness in which a student is under the care of a doctor and physically unable to attend class will be excused. Students are not excused for a doctor's appointment. Do not make appointments that conflict with rehearsals. Notes from the University Health Center will be accepted.

[Executive Rules for Study Regulations and Exams](http://goo.gl/ykm7t3)

goo.gl/ykm7t3

