PHYS-309 **Solid state physics I**

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Cursus	Sem.	Type
Physics	BA5	Obl.

Language of teaching	English
Credits	3
Session	Winter
Semester	Fall
Exam	Written
Workload	90h
Weeks	14
Hours	**3 weekly**
Lecture	2 weekly
Exercises	1 weekly
Number of positions	

Summary

This lecture gives an introduction to Solid State Physics, namely to their crystal and electronic structure, their magnetic properties, as well as to their thermal and electric conductance. The level is that of Ashcroft & Mermin. The lecture is conceived for Physics Students in their 3rd year.

Content

The Drude model of metals: DC electrical conductivity, Hall effect, AC electrical conductivity, thermal conductivity.

The Fermi free electron gas: ground-state and thermal properties of the free electron gas, Pauli paramagnetism, Sommerfelf theory of conduction in metals.

Lattice dynamics: normal modes of a monoatomic Bravais lattice in 1 and 3 dimensions, 3-dimensional lattice with a basis, quantification of elastic waves, neutron scattering by a crystal.

Thermal properties in relation with phonon: specific heat of the lattice, models of Debye and Einstein, anharmonic effects.

The lecture is accompanied by an introduction to crystallography in real and reciprocal space, and we introduce Fermi-Dirac and Bose-Einstein statistics. The first subject is treated in much more detail in a specialized lecture which, we highly recommend. The second is treated in the second semester of the lecture on statistical Physics.

Learning Outcomes

By the end of the course, the student must be able to:

- Distinguish between heat transport by electrons and phonons
- Differentiate between specific heat of electrons and phonons
- Compute the electrical conductivity
- Compute the specific heat of electrons
- Compute the specific heat of phonons
- Sketch the lattice in real and reciprocal space
- Argue about the number of k-points in the first Brillouin zone

Transversal skills

- Use a work methodology appropriate to the task.
- Communicate effectively with professionals from other disciplines.

Teaching methods

Ex cathedra and exercises in class

Assessment methods

Written exam in English (100%), answers in French allowed

Prerequisite for

Solid State Physics III, IV