MAPR2110 Introduction to materials physics

[45h+30h exercises] 6 credits

This course is taught in the 1st semester

Teacher(s):	Patrick Bertrand, Jean-Christophe Charlier (coord.), Arnaud Delcorte, Xavier Gonze, Luc Piraux, Gian-Marco Rignanese
Language:	French
Level:	Second cycle

Aims

- Complements of quantum mechanics, in view of the understanding of material cohesion and their response to perturbations
- Elements of statistical physics, leading to the energy distribution of electrons and lattice vibrations in materials
- Phenomenological approach of material properties, based on thermodynamical constraints, and linked to the materials symmetry.

Main themes

This lecture presents the basics of materials physics (complements of quantum mechanics ; statistical physics ; symmetries and thermodynamics)

Content and teaching methods

Lectures " ex cathedra " : presentation of the concepts
Exercices, in view of a better understanding of the subject.
I. Complements of quantum mechanics
1. Reviews : postulates, measure theory, hydrogen atom, spin, periodic table
2. Matrix mechanics
3. Study of the harmonic oscillator (Dirac technique)
4. Variational principle
5. Tight-binding approximation
6. Elements of molecular physics (bonding and electronic structure)
7. Perturbation theory
II. Statistical physics
1. Introduction
2. Elements of statistical physics (microcanonical ensemble)
3. Gibbs distribution (canonical ensemble)
4. Grand canonical ensemble
5. Quantum fluids
6. Statistical formulation of thermodynamical functions
III. Symmetry and thermodynamics
1. Symmetry and tensors
2. Polar dielectrics
3. Piezoelectricity
4. Generalized crystalline thermodynamics
5. Transport and magnetic field

Other information (prerequisite, evaluation (assessment methods), course materials recommended readings, ...)

Nil

Other credits in programs

MAP22	Deuxième année du programme conduisant au grade d'ingénieur civil en mathématiques appliquées	(6 credits)	
MATR21	Première année du programme conduisant au grade d'ingénieur civil en science des matériaux	(6 credits)	Mandatory