

MSE-423

Fundamentals of solid-state materials

Marzari Nicola

Cursus	Sem.	Type
Materials Science and Engineering	MA1, MA3	Obl.

Language of teaching	English
Credits	4
Session	Winter
Semester	Fall
Exam	Oral
Workload	120h
Weeks	14
Hours	4 weekly
Courses	3 weekly
Exercises	1 weekly
Number of positions	

Summary

Fundamentals of quantum mechanics as applied to atoms, molecules, and solids. Electronic, optical, and magnetic properties of solids.

Content

Fundamentals of electronic structure: the Schroedinger equation and its solution for free electrons, electrons in a potential well, and in a Coulomb potential. Variational principle and diagonalization. Electronic structure of molecules, and approximate solutions with linear combination of atomic orbitals. Hartree-Fock. Symmetry operation and their role in classifying eigenstates. Hamiltonian in a periodic potential and energy bands. Free-electron and tight-binding models. Fermi-Dirac statistics and distribution. Electrical transport and semiconductors. Optical properties of materials, and their quantum origin. Magnetic properties of materials.

Learning Prerequisites**Required courses**

Basic knowledge of classical mechanics and electromagnetism.

Learning Outcomes

- Elaborate the electronic origin of materials properties

Assessment methods

Oral exam