English Course Catalogue - Template

Discipline	***Chemistry***
Title of the course	*Solid State Physics*
Code	
Duration and Date start Date end	*11 weeks (spring semester) March - end of May*
Course coordinators and contact details	*Cedric CRESPOS cedric.crespos@u-bordeaux.fr Alexandre BARON alexandre.baron@u-bordeaux.fr*
Other contact person	*Corinne JALIBERT corinne.jalibert@u-bordeaux.fr*
Mode of delivery	*Learning mode = in-class 35 contact hours Assessment procedure = final exam + project evaluation*
Level	*Master*
ECTS credit points	*6 ECTS 126 hours = 41 contact hours (35 lectures and tutorials, 6 practicals on computer); 82 hours self-study; 3 hours + project for assessment.*
Language	*English*
Description[1]	The objective of this course is to provide the students with the basics of solid-state physics. Prerequisites of statistical physics and quantum theory are required as well as basic concepts in optics. Fundamental concepts will be illustrated all along the lectures by means of practical examples. A first part of the course is devoted to the main models of electronic structure in periodic systems are exposed (Fermi free electron gas, nearly free electrons in a perturbation theory) and illustrated by simple benchmark examples. An introduction to the physics of lattice dynamics is also proposed in a last chapter devoted to the theory of Phonons in solids. In a second part, the optical properties of the solid state are presented.
Content	*Lectures:* • *Elementary classical and quantum aspects of the free electron theory of metals.* • *Electrons in a weak periodic potential: Bloch's Theorem, perturbation theory applied to periodic potentials, band structure, Fermi surfaces and Brillouin zones, nearly free electrons model.* • *General properties of semiconductors.* • *The Tight-Binding model, a chemist's view of bonding in solids.*

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	• *Phonons and lattice vibrations: classical and quantum theories of the Harmonic crystals, normal modes, elementary theory of the phonon dispersion relation, electron-phonon interaction.* • *Electromagnetism in matter: Maxwell's equations, polarization, dielectric constant, the propagation equation, reflectance, transmittance and absorption, dielectric, metals and semiconductors, blackbody radiation* • *Optical properties of metals* • *Optical properties of nanoparticles* • *Photonic applications: sensors, LED's, quantum dots, solid state lasers, spectroscopy, photonic crystals* *Practicals:* • *Computational procedure for the study of periodic systems* • *Energy minimization and ground-state properties calculations.* • *Structural optimization, Lattice relaxation.* • *Calculation of density of states and bands diagrams.*
Methods	*Lectures, tutorials on computers, project.*
Assessment procedures	*Type of assessment / first session: written exam (60% weight of overall mark) at the end of the semester, project evaluation (40% weight of overall mark).* *In case of failures/second session: written exam (60% weight of overall mark) at the end of the semester, project evaluation (recall of the first session mark).*
Prerequisites	*Prerequisites: Basics in quantum mechanics, statistical physics, notions of geometrical optics* *(Undergraduate level)*
Other information	