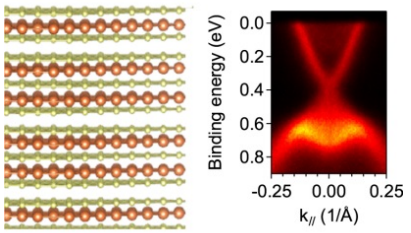
SCIENCES SORBONNE UNIVERSITÉ

MASTER
Physique fondamentale et applications

SMNO nanomat master

M2–SMNO-nanomat–CMP1

Title	Condensed Matter Physics – level 1 (CMP1)	
	Apogée code: MU5PYM01 **Number of credits:** 3 **Teaching hours:** 26h	

Lecturer	Prof. Massimiliano Marangolo (coordinator) INSP – Office 23-22 –3rd floor marangolo@insp.jussieu.fr

Objective	This course introduces the fundamental basis of condensed matter physics. The objectives are: • to master simple models of phonon band structure calculation and to make the link with thermal properties • to understand and master the main models allowing for the description of the electronic band structure of ordered solids • to use the band structure in order to predict and calculate the electronic properties of a crystalline system • to introduce the physics of semi-conductors and of simple fundamental devices
Content	**Phonons & thermal properties**: Classical theory of the harmonic crystal, dynamical matrix, acoustic/optical modes. Quantization, phonons. Reminder on Bose-Einstein statistics. Thermal properties of crystalline matter. **Electronic properties of crystals**: Born-Oppenheimer and independent electrons approximations, core and valence electrons, periodic potential and Bloch theorem, band structure, simple models: tight-binding and nearly free electrons. **Metals, semiconductors, insulators:** Reminder on Fermi-Dirac statistics, valence and conduction band, electron/hole. Link between the band structure and the electronic properties. **Electronic transport**: Bloch wave-packet, semi-classical dynamics of electrons, effective mass, electronic transport in the relaxation time approximation. **Semiconductors**: intrinsic, doping, conductivity, electronic devices (p-n junction, transistors).
Prerequisites	Crystallography: Bravais lattice, reciprocal lattice, diffraction. Quantum mechanics: perturbation theory. Statistical physics: Fermi-Dirac and Bose-Einstein statistics. Mathematics: Fourier transforms and distributions.
Examination	Written examination / 100