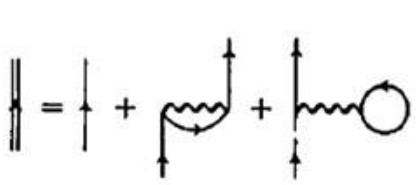
SCIENCES SORBONNE UNIVERSITÉ

MASTER
Physique fondamentale et applications

SMNO nanomat master

M2 – SMNO-nanomat – CMP3

Title:	Condensed Matter Physics – level 3 electronic and transport properties (CMP3)	
	Apogée code: MU5PYM03 **Number of credits:** 3 **Teaching hours:** 30 h lectures & tutorials	

Lecturers:	Andrea GAUZZI (coordinator) IMPMC– 23-13 – 411 andrea.gauzzi@sorbonne-universite.fr	Massimiliano Marangolo INSP marangolo@insp.jussieu.fr

Objective	Introduction to the electronic properties of solids beyond the independent electron approximation. Applying the basic notions of band theory to the phenomena of charge and thermal transport. Introduction to the second quantisation formalism as most suitable framework to study the fundamental scattering processes.
Content	1. Revision of band theory. Quasi-free electron and tight-binding approximations. 2. Beyond the independent electron approximation. Hartree-Fock approximation. Slater determinants. 3. Application of Hartree-Fock approximation to metals. 4. Transport theory. Boltzmann kinetic equation. Limits of validity. 5. Electrical conductivity of metals and semiconductors. 6. Thermal conductivity of metals. 7. Born-Oppenheimer approximation. Limits of validity. 8. Second quantisation. Application to fermions and bosons. 9. Quantisation of the electromagnetic field (photons) or of the elastic field (phonons) 10. Phonons in solids. Debye theory of the specific heat. 11. Application of second quantisation to electron-phonon scattering. 12. Bloch-Sommerfeld theory of electrical resistivity.
Prerequisites	Fundamentals of atomic and molecular physics. Conventional band theory within the independent electron approximation. Quasi-free electron model. Tight-binding approximation. Classical description of lattice vibrations in solids.
Examination	Written exam on the subjects treated during the lectures and the tutorials.