



COMPLEMENTS OF STRUCTURE OF MATTER

Enrollment year	2016/2017
Academic year	2017/2018
Regulations	DM270
Academic discipline	FIS/03 (MATERIAL PHYSICS)
Department	DEPARTMENT OF PHYSICS
Course	
Curriculum	Didattica e storia della fisica
Year of study	2°
Period	1st semester (02/10/2017 - 19/01/2018)
ECTS	6
Lesson hours	48 lesson hours
Language	Italian or English upon request (English friendly course - http://fisica.unipv.it/dida/English-friendly-programme.pdf)
Activity type	ORAL TEST
Teacher	CARRETTA PIETRO (titolare) - 4 ECTS PRANDO GIACOMO - 2 ECTS
Prerequisites	Knowledge of the basic aspects of quantum mechanics, statistical mechanics and the foundations of solid state physics, namely the lattice structures, the electronic bands and the lattice vibrations. The student should have already learned those aspects during the first three years of university.
Learning outcomes	Learning of the basic aspects of phase transitions and the fundamental properties of magnetic and superconducting materials.
Course contents	First the general aspects of phase transitions will be introduced: phenomenology, first and second order transitions, the order parameter, the response functions, the critical exponents, the correlation function and their behaviour on approaching a phase transition, the correlation effects among critical variables and the Stoner-Hubbard model. Then

	<p>the course will address the magnetic properties of matter starting from the metals: the generalized susceptibility, the Landau levels, de Haas-Van Alphen effect, Landau diamagnetism, Pauli paramagnetism, dimensionality effects and the spin density waves. Then the basic aspects involved in the paramagnetism of insulators are recalled and the direct and indirect exchange interactions treated. The static properties and excitations in ferromagnets, antiferromagnets and in other types of magnetically ordered systems are presented. The effects of magnetic frustration are outlined and the main properties of molecular magnets described. Then the basic aspects of superconductors will be introduced: their thermodynamic properties, the London equations, the Cooper pair formation, the gap and the isotope effect, the Josephson effect and the SQUID, the Ginzburg-Landau theory. Finally some techniques which allow to investigate the basic properties of magnetic and superconducting materials will be presented: magnetometry, NMR, μSR and neutron scattering.</p>
Teaching methods	Lectures and problem solving, trying to keep a high interactive level with the students.
Reccomended or required readings	<p>A. Rigamonti and P. Carretta, Structure of Matter (3rd Edition) Springer International Pub. (2015)</p> <p>G. Grosso and G. Pastori Parravicini, Solid State Physics (Academic Press, 2000).</p> <p>H. Eugene Stanley, Introduction to Phase Transitions and Critical Phenomena (Oxford University Press)</p> <p>C. Kittel, Introduction to Solid State Physics (John Wiley & Sons 2005)</p>
Assessment methods	Oral exam. The students should concentrate on the comprehension of the physical aspects involved and focus on the qualitative behaviour of the various quantities and on the experimental methods used to derive them.
Further information	Oral exam. The students should concentrate on the comprehension of the physical aspects involved and focus on the qualitative behaviour of the various quantities and on the experimental methods used to derive them.
Sustainable development goals - Agenda 2030	\$Ibl legenda sviluppo sostenibile