Basic/Essential Course Information	
Course title	Condensed Matter Physics
Degree Course title	Physics
ECTS	6
Compulsory attendance	No
Course teaching language	ENGLISH

Teacher	Gaetano Scamarcio	gaetano.scamarcio@uniba.it

ECTS Details	Disciplinary area/broad field:	SSD	ECTS
	Characterizing	FIS/03	6

Time management and teaching activity type	Period	Year	lesson type
	1st semester	1st	Lessons (40h) Laboratory (15h)

Time management,	Total hours	in-class/in-lab study hours	out-of-class study hours
	150	55	95

Course calendar	Starting date	Ending date
	Third week of September	Third week of December

Syllabus	
Prerequisites	Background knowledge on quantum physics, statistical physics and solid state physics at the level of bachelor degree in physics.
Expected learning outcomes (according to Dublin Descriptors)	**Knowledge and understanding of:** • basic and advanced aspects of condensed matter structure • surface structure and related experimental techniques • mesoscopic transport phenomena under applied electric and/or high magnetic fields • radiation-matter interaction in solids • physics of lasers **Applying knowledge and understanding:** • ability to focus on the essential description of physical phenomena with emphasis on the assessment of physical limits **Making judgements:** • ability to choose suitable methods to describe and measure relevant structural, vibrational, optical and surface properties of condensed matter **Transferable Communication skills:** • communication skills in English; • skills in the exposition of physical phenomena and experimental results using appropriate scientific language; **Lifelong learning skills:**

	• ability to learn and to transfer experimental methods for the assessment of relevant physical properties of matter
Course contents summary	Structural, electronic, vibrational, optical and transport properties of condensed matter.
detailed syllabus	Order and disorder in condensed matter. Bulk properties of crystals. Fourier analysis and reciprocal lattice. X-ray scattering. Maximum packing in solids. Colloidal crystals. Liquid crystals. The exchange interaction and magnetic order. Magnetic phase transitions. Ferromagnetic domains. Neutron diffraction. Surface structure and crystal growth. Surfaces and surface tension in solids. Roughening. Equilibrium crystal shapes. Non-equilibrium crystal growth: molecular beam epitaxy. Experimental methods to observe surfaces: scanning probe microscopies (STM, AFM); scanning electron microscopy (SEM); high-energy electron diffraction. Classical and quantum waves in solids. Lattice vibrations, acoustic and optical modes in three dimensions. Phonons. Dielectric function and its dispersion. Phonon-polaritons. Plasmons. Spin waves. Transport of free carriers under large magnetic fields. Landau levels and quantization of magnetic flux. Quantum Hall effect. Loughlin model. Transport in mesoscopic systems. Landauer model. Quantization of conductance. Quantum point contacts. Coulomb blockade. Colossal magnetoresistance and basic principles of spintronics. Introduction to the physics of lasers. Spontaneous and stimulated emission. Light-matter interaction. Population inversion. Four-level scheme. Rate equations. Properties of laser beams. Temporal and spatial coherence. Decoherence and dephasing. Homogeneous and inhomogeneous line broadening. Q-switching. Mode-locking. Relevant examples of classes of laser.
books	- L. Sander, "Advanced condensed matter physics", Cambridge, 2009 - A. E. Siegman, "Lasers", University Science books, 1986 Suggested readings: - Kittel, "Introduction to Solid State Physics", Wiley, 2005. - N. W. Ashcroft, N. D. Mermin, "Solid state physics", Thomson Brooks, 1976.
notes	Selected chapters
Teaching methods	Lectures in the teaching room with the aid of a laptop and a projector. Laboratory visits and demonstrations.
Assessment % of final mark	Oral exam (100%)
Evaluation criteria	Knowing the basic principle of condensed matter structure. Knowing the phenomena supporting present knowledge of condensed matter structure. Knowing the main experimental methods to study the properties of solids and surfaces. Knowing successful models describing the condensed state of matter. Showing the capability to discuss the interconnection between individual components of solids and related interaction phenomena.