TABELLA A

Title / teacher	CFU	Hours	Semester	Description	Assessment criteria
Carbon nanostructures for energy applications *Prof. Mauro Riccò*	2	16	1	The course is primarily concerned with providing the basic knowledge on nanostructured materials consisting of carbon only as: Fullerenes,Graphene, Nanotubes, Nanographites and Onions. The study of thesematerials is a frontier field of modern research and the reached todayknowledge of these systems suggests that they may form the basis ofmany future technological applications. Their expertise should thereforebe an important basis for the formation of the future physicist andchemist who deals with condensed matter but not only.	Seminar on an advanced topic related to the course
Magnetic properties of materials from nano to macro *Prof. Massimo Solzi* *Dott.ssa Franca Albertini*	2	16	1	These lectures provide an overview of the basic properties of magnetically ordered solid materials and their explanation in atomic terms. In addition, the effects of fundamental interactions on the magnetic phenomenology at the different length scales will be highlighted. The students will become familiar with the main concepts, effects and definitions, which constitute the necessary basis for understanding the current topics of modern magnetism. These concepts will be adopted for explaining the magnetic and multi-functional properties of some emerging classes of magnetic materials in frontier applications in the fields of energy, biomedicine and information technology. Some of the main covered topics are: • Magnetic moments in free atoms and ions, diamagnetism • Assembly of atoms, paramagnetism • Exchange interactions and ferromagnetism • Magnetism in metals • Anti-ferromagnetism, ferrimagnetism and non collinear order • Crystal field effects and magnetic anisotropy • Magnetic domains and the magnetization process • Magnetic materials for energy conversion applications • Magnetic thin films and nanostructures • Relevant lenghtscales in magnetism • Superparamagnetism, interface and surface anisotropy • Magnetic materials for biomedical applications	Seminar on an advanced topic related to the course

Introduction to Raman Spectroscopy *Prof. Matteo Masino*	1	8	2	Description of light scattering and Raman scattering. Resonance Ramanintensity in the framework of the Albrecht's theory. Micro-Raman mapping, SERS and TERS phenomena. Comparison of the different techniques.	Oral exam
Transport properties of semiconductors. *Prof. Antonella Parisini*	2	16	1	The course offers an introduction to transport properties insemiconductors, focusing on inorganic semiconductors with tetrahedral coordination. The electric charge conduction in this class of materials willbe discussed in the light of the occupancy of electrically active impurities,of the electronic transport mechanisms, of compensation effects. The roleof electronic properties of semiconductors in device design will be discussed, considering the effects of both shallow impurities and deep levels. Experimental methods for the investigation of low-field transportproperties will be discussed, with the possibility of visiting research laboratories and assisting in measurements. It will be possible to proposeinsights on specific topics, in relation to the interests expressed by the students, such as: transport at high electric fields, classical and quantummagneto-transport or transport through p-n junctions. The areas towards which research on semiconductors is mainly oriented today willbe outlined.	Seminar on an advanced topic related to the course
Advanced fluorescence techniques *Prof. Cristina Sissa*	1	8	2	Topics include time-resolved emission spectroscopy (fluorescence and phosphorescence), fluorescence anisotropy, and circularly polarized luminescence (CPL). Student-proposed case studies are encouraged and welcome.	Oral exam
Electron microscopy techniques for materials *Prof. Laura Lazzarini*	2	16	1	Introduction to the importance of the Electron Microscopy techniques in Materials Science Basics of the Microscope Operation: magnetic lenses, resolution, lens defects. Scanning versus Transmission mode. Diffractioncontrast in TEM images. The diffraction pattern. Two-beam condition. Defects imaging. Chemical sensitive imaging. Phase contrast: Principles of the phase contrast. High Resolution Electron Microscopy. The importance of the simulations. TEM related techniques: Scanning TEM (Z-contrast), X-ray microanalysis, Energy Loss Spectroscopy, Cathode- luminescence. Applications: Defects and compositional contrast in low dimensional hetero structures; identification of new crystal phases by means of the STEM-HAADF technique; high resolution cathode-luminescence spectroscopy on single nanostructures.	Seminar on an advanced topic related to the course

Synthesis and characterization of porous organic materials *Prof. Alessandro Pedrini*	1	*8*	*2*	The course will highlight the principal methodologies for the synthesis and characterization of microporous organic materials, such as covalent organic frameworks (COFs), porous aromatic frameworks (PAFs) and polymers of intrinsic microporosity (PIMs). The focus will be placed on relevant applications in gas adsorption and separation and water treatment.	Seminar on an advanced topic related to the course
DNA Nanotechnology and Amplification Strategies for Biomolecular Sensing *Prof. Alessandro Bertucci*	1	*8*	*1*	Fundamentals of DNA nanotechnology and bioanalytical applications: programmable interactions between nucleic acids, unimolecular and multimolecular DNA structures, aptamers and SELEX process, dynamic reaction mechanisms in functional DNA nanotechnology, DNA switches. Nucleic acid amplification: enzymatic amplification techniques, non-enzymatic amplification techniques, techniques based on CRISPR-Cas technologies.	Seminar on an advanced topic related to the course

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