Prof. Mario Pelino

Programme of "Scienza e Tecnologia dei Materiali " ***"Science and Technology of Materials"***		
Number of ECTS credits: 6 (workload is 150 hours; 1 credit = 25 hours)		
I0633, Compulsory; II Semester Teacher: **Mario Pelino**		
1	**Course objectives and Learning outcomes**	**Links and cultural aims of the course**: the course aims to provide students with the fundamentals of chemistry and solid state physics applied to the study of materials science and technologies. The chemical, thermal, mechanical are put in relation to the structures, composition, morphology, phases. The properties and applications of ferrous and non-ferrous (aluminium, nickel, copper), traditional and advanced ceramics and glass-ceramics, polymers is detailed in the second part of the course.
2	**Dublin descriptors**	**Topics of the module include**: Elements of general chemistry , structure of atoms and molecules. Atomic bond of solids. Covalent and ionic solids metallic . The crystal structures . The Miller indices . Plans and directions at maximum density . Solidification. Defects in crystals : the grain boundaries , Frenkel and Schottky defects , dislocations stacking faults . The sources of Franch and Read. X-ray diffraction and Bragg's law . The solids under stress : the movement of atoms in the crystal lattice . Fick's laws of diffusion . Diffusion in metals, in the oxides in the glass. Mechanical tests on materials: strength, fatigue, toughness, hardness, creep . Thermodynamics of solid solutions . The Gibbs phase rule . Partial and complete miscibility . Immiscibility . Characteristic points in the phase diagrams. Diagrams of Fe-C , Al- Cu , Cu -Zn , Cu -Sn . Phase diagrams of silica - alumina. Ternary diagrams . The solidification process . Nucleation and growth , sub- cooling and glassy state . The metal alloys, ferrous : . Curves Bain , the isotherms and an- isotherm quenching and tempering , annealing, normalising . The steels, carbon steels. Austenitic stainless steels , ferritic and martensitic steels. The steels for cryogenic and high temperatures . The special alloys. The non ferrous alloys : aluminium alloy hardening and work hardening. Alloys by extrusion and reclamation . Anodizing . Alloys of copper. Brass, bronze, cupro-nickel. Nickel alloys: properties, technology and application. **The ceramics** : Crystalline structures, the structure of silicates, defects in ceramic materials, brittle fracture, stress-strain behaviour, scientific aspects of sintering; fabrication techniques. Traditional and advanced ceramics , thermal and electrical properties . Techniques for inducing toughening in ceramics . Properties of glasses, lattice formers and modifiers , the glass transition temperatures, temperature vs viscosity curves; heat treatment of the glass. Glass - ceramics : nucleation and crystallisation; properties and applications . Polymers: Polymerization reactions : thermoplastic polymers , thermosetting . The vulcanization process of the elastomers.
3	**Prerequisites and learning activities**	The student must know the basic notions of General Chemistry, Physics and Mathematics
4	**Teaching methods and language**	Lectures and exercises. Language: Italian / English **Ref. Text books** • W.F. SMITH - SCIENZA E TECNOLOGIA DEI MATERIALI - MCGRAW-HILL • W. NICODEMI. METALLURGIA - ED. MASSON • W.D. CALLISTER - MATERIALS SCIENCE AND ENGINEERING - JOHN WILEY AND SONS, INC.
5	**Assessment methods**	Oral exam.