Material Field		Microscopic approach	Total of teaching hours : 92 hrs		
			Course	Supervised work	Lab work
MT I3.5	3 ECTS credits		36 hrs		24 hrs
			4 hrs evaluation - 28 hrs individual work		

Objectives

- Introduction to the Science of Materials. The goal is to provide the tools necessary for understanding the properties of the different materials and to predict their behaviour.
- Acquire knowledge of the major families of materials (metals, polymers, ceramics, and composites) in their structures and properties.
- Make the link between microscopic structures and macroscopic properties.

(taxonomic level : application and analysis)

Prerequisites and links to other modules

- Classification of different atoms, energy states of atoms, the material's architecture (crystallography, link types)
- Macroscopic thermodynamics
- Concepts of probability

Chapter 1 **Atomic and molecular architecture**	○ Electronic structure of the atom ○ Links ○ Organisation of a solid state (amorphous, crystal) ○ Crystallography
Chapter 2 **Elasticity and elastic limit**	○ Empirical approach (highlighting the concepts of constraint and deformation) ○ Modelling of the elastic response of a system of two atoms ○ Generalisation of the model into the crystalline solid ○ Highlighting of the inadequacy of the model to predict the elasticity limits
Chapter 3 **Crystalline defects. Diffusion**	○ Specific defects (gaps, impurities, solid solutions) ○ Linear defects (dislocations) and the role of dislocations in the plastic deformation ○ Defects with two dimensions (external surfaces, surface energy, grain boundaries, twin crystals) ○ Diffusion mechanisms (lacunar and interstitial) Fick's laws
Chapter 4 **Plasticity and crystalline defects**	Hardening - Effect of the microstructure - Effect of solid solution - Structural hardening
Chapter 5 **Balance diagrams**	○ Definitions (phases, solvent, solute, solid solution, defined compound, etc.) ○ Variance (Gibbs' phase rule) ○ Rules for establishing and reading binary diagrams ○ Using diagrams (law of mass action ...) ○ Application to the iron-carbon diagram; micro-structure of steels and irons