



## MAPR2805 Introduction to materials science

[45h] 4 credits

This course is taught in the 1st semester

**Teacher(s):** Jean-Christophe Charlier, Roger Legras (coord.), Thomas Pardoën  
**Language:** French  
**Level:** Second cycle

### Aims

Provide a description of chemical bonding in relationship with materials classes, of consequent microstructures, and of resulting structural and functional properties;

Provide basic thermodynamic and kinetic concepts for materials processing. The course provides a unified picture of materials, beyond specifics associated with materials classes, while explaining the particular behavior of specific materials.

### Main themes

The course is divided into 3 parts. The first part is centred on the chemical bond concept, allowing the classification of materials. In a second part, various functional properties of materials are described. At last, the third part proposes an introduction to materials engineering for metals, ceramics and polymers. The aim of the present course consists in the illustration of the link between macroscopic properties of various classes of materials and the fundamental aspect of matter, from its atomic or molecular level to its microstructure.

### Content and teaching methods

Content :

#### 1. Introduction

Historical and economical aspects, materials classes, selection of materials, plan.

#### 2. Chemical bonding and introduction to crystallography

##### 1. Chemical bonding

Types of bonds, main polymerization reactions, tacticity, molecular architecture.

##### 2. Introduction to crystallography

##### 3. Crystal defects

##### 3. Functional properties of materials

###### 1. Bases of quantum mechanics

###### 2. Elastic waves in solids

###### 3. Free and quasi-free electrons

###### 4. Electrical conductivity

###### 5. Thermal conductivity

###### 6. Dielectric, optical and magnetic properties

#### 4. Materials engineering

##### 1. Formation and evolution of microstructures

##### 2. Strain behaviour

##### 3. Lifetime

##### 4. Relationships between molecular architecture/ microstructure/ properties for polymeric materials.

Methods :

Ex-cathedra courses, with numerous industrial and academic examples.

**Other information (prerequisite, evaluation (assessment methods), course materials recommended readings, ...)**

Basic notions in chemistry, physics and thermodynamics.

**Programmes in which this activity is taught**

**MAP2**                    Ingénieur civil en mathématiques appliquées

**Other credits in programs**

<b>ELEC22</b>	Deuxième année du programme conduisant au grade d'ingénieur civil électricien	(4 credits)	
<b>ELME21/E</b>	Première année du programme conduisant au grade d'ingénieur civil électro-mécanicien (énergie)	(4 credits)	Mandatory
<b>ELME22/E</b>	Deuxième année du programme conduisant au grade d'ingénieur civil électro-mécanicien (énergie)	(4 credits)	
<b>ELME23/M</b>	Troisième année du programme conduisant au grade d'ingénieur civil électro-mécanicien (mécatronique)	(4 credits)	
<b>INCH21</b>	Première année du programme conduisant au grade d'ingénieur civil chimiste	(4 credits)	Mandatory
<b>MAP21</b>	Première année du programme conduisant au grade d'ingénieur civil en mathématiques appliquées	(4 credits)	
<b>MATR21</b>	Première année du programme conduisant au grade d'ingénieur civil en science des matériaux	(4 credits)	Mandatory
<b>MECA21</b>	Première année du programme conduisant au grade d'ingénieur civil mécanicien	(4 credits)	Mandatory