UCL Université catholique de Louvain

# LMAPR1805

*2014-2015*

# Introduction to materials science

| 3.0 credits | 30.0 h | 2q |
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| Teacher(s) : | Nysten Bernard ; Charlier Jean-Christophe ; Pardoen Thomas ; |
| Language : | Français |
| Place of the course | Louvain-la-Neuve |
| Inline resources: | > http://icampus.uclouvain.be/claroline/course/index.php?cid=MAPR1805 |
| Main themes : | The objective of the course is to provide an introduction to materials science as a science that aims at linking the process, structure and properties of materials on the basis of the principles of chemistry, physico-chemistry, thermodynamics, quantum mechanics, physics and mechanics of solids. |
| Aims : | Contribution of the course to the program objectives<br>Having regard to the LO of the programme 'Bachelor in engineering', this activitycontributes to the development and acquisition of the following LO:<br>LO 1.1 1.2<br>Specific learning outcomes of the course<br>At the end of this course, the student will be able to<br>--<br>LO1.1. position materials science within its wider context of a discipline useful in most engineering technologies;<br>--<br>LO1.1 know, define, and correctly use the vocabulary and notations of the discipline (e.g. capacity of define notions like lattice, atom, molecule, phase, eutectic, electron, phonon, tacticity, grain, precipitate, dislocation, conformation, stress, strain, stiffness, strength, conductivity, etc);<br>--<br>LO1.1 describe with words and schematic drawings the chemical bonds at the basis of the different classes of materials, the amorphous and crystalline structures, the crystalline defects, the molecular architecture and microstructure, the physico-chemical/ thermodynamics mechanisms at the origin of the microstructures;<br>--<br>LO1.2 apply the basic concepts of crystallography, thermodynamics and phase diagrams to the solution of simple exercises;<br>--<br>LO1.1 explain based on words and schematic drawings the links between the material structure and the functional (electrical and thermal conductivity, optical indices, dielectric and magnetic coefficients, etc) and mechanical properties (enthalpic and entropic elasticity, glass transition, strength, ductility, etc);<br>--<br>LO1.1 master the notations, time, length and temperature scales, orders of magnitudes involved in the representation of the evolution of the functional and mechanical properties of the difference classes of materials;<br>--<br>LO1.1 derive, based on the properties, the main field of applications of the classes of materials based on a global vision of materials science which goes beyond the classes of materials but which also explains the particular behaviours.<br>*The contribution of this Teaching Unit to the development and command of the skills and learning outcomes of the programme(s) can be accessed at the end of this sheet, in the section entitled "Programmes/courses offering this Teaching Unit".* |
| Evaluation methods : | The students will be individually graded based on a written exam with questions related to the material seen during the ex-cathedra courses, as well as the solution of exercises in the vein of those addressed during the semester. |
| Teaching methods : | Ex-cathedra courses and practical exercises mainly. One or two laboratories. |
| Content : | General introduction<br>Partie I ' Materials structure and genesis of microstructures<br>A. Reminder on the chemical bonds and material states<br>B. Thermodynamics of interfaces, diffusion, nucleation, growth<br>C. Phase diagrams<br>D. Crystalline materials (involving basics of crystallography, solidification, description of defects and microstructures)<br>E. Amorphous materials (involving main polymerization reactions, tacticity and molecular architecture, amorphous solids, polymorphism, brief introduction to glasses)<br>The sections A, B & mp; C are transverse to all classes of materials.<br>Exercises will be given for the crystallography and thermodynamics aspects.<br>Partie II ' Functional properties<br>A. Electrons and phonons<br>B. Electrical and thermal conductivity ( + one lab session on electrical measurements) |

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| | C. Dielectric, magnetic and optical properties<br>Partie III ' Thermomechanical properties<br>A. Macroscopic mechanical behaviour (+ exercises and lab session)<br>B. Relationships between molecular architecture / microstructure / thermomechanical properties of polymers<br>C. Relationships between defects / microstructure / thermomechanical properties of metals and ceramics |
| Bibliography : | Textbook and slides available on i-campus + introductionary books on materials science available at BSE. |
| Other infos : | The students must be familiar with the elementary concepts of chemistry, physics, mechanics |
| Cycle and year of study : | > Bachelor in Engineering<br>> Master [120] in Biomedical Engineering |
| Faculty or entity in charge: | FYKI |