

Conception and Selection of Materials and Processes

ECTS	Course (h)
3	18

Mention du master transmettant la fiche UE :	Chimie et Sciences des Matériaux
Composante de gestion de l'UE :	Faculté des Sciences – Département de Chimie
Responsable de l'UE :	Olivier DEZELLUS
Statut du responsable :	MCF

REQUIREMENTS

Materials Sciences: M1- Chemistry and Materials Science
Notion of solid mechanics (stresses-strains-elasticity-plasticity)

PROGRAMM

Objectives: At the end of this course, the student will be able, in a structural part design problem, to define Materials-Process specifications taking into account multiple constraints (part performance, eco-design, processing, cost, ...). From these specifications and in-depth knowledge of the behavior (in particular thermomechanical) of materials at different scales, he will be competent to set up and use a material selection method and to implement multi-optimization processes. criteria such as proposing avenues for the development of new materials.

The design of new devices and uses is the basis of innovation, and it is therefore a major issue in the industrial world. It is based on many tools, including material and process selection methods. These methods bring into play numerous technical criteria relating both to the performance of the materials and to the possibilities of implementation processes, to the available forms, to the costs and to the ecological impacts.

This course aims to present a rational method, allowing to operate an optimal choice of materials, forms and processes in the design of industrial products. By establishing and taking into account well-defined specifications, in terms of objectives and constraints, we show how it is possible to define performance closely linked to the thermomechanical behavior of materials. From a multi-scale description of this behavior, we show how it is possible to systematically and scientifically obtain the best combination of materials and technologies for a given technical objective, or even to provide elements for the development of innovative materials.

The method proposed is that of performance indices defined by Mr. ASHBY and the course is accompanied by practice of specific software.

The course will cover the following points:

- Design methodology.
- Functional specifications
- Performance indices (definition, calculation).
- Thermomechanical behavior of materials (elasticity, plasticity, rupture) at different scales under elementary mechanical stresses (traction, compression, shear, punctual contact)
- Property maps, use of performance indices for the choice of materials.
- Taking into account the form and the process in the selection.
- Multi-constraints selection.
- Use of a specific software

SKILLS

- Master the definition of a Materials-Process specification in a part design problem

- Master the method of selecting materials from the definition of the performance index
- Master a multiscale approach of the thermomechanical behavior of materials
- Know the different families of materials and their thermomechanical properties
- Know the mechanisms, at different scales, associated with the mechanical behavior of materials
- To know the elementary relations of the thermomechanical behavior of materials in connection with their processing