



Introduction

In the process of designing and manufacturing industrial parts and systems, engineers are required to make judicious use of materials and even to give them new functionality. This approach is the basis of the design and innovation process. It involves on a wide range of knowledge from the field of engineering sciences; this is known as "Materials Engineering". The aim of the courses proposed by the "Materials Engineering" unit is to introduce students to materials science by enabling them to address problems at different scales, with respect to the behaviour of the material and taking into account its entire life cycle, from its development to its recycling, including its shaping, specific optimization treatments and damage. The focus is on structural materials and their behaviour, but electrical, thermal and magnetic properties are also studied. Thus, by organizing the pedagogy around the acquisition of a body of knowledge, know-how and specific methodologies, students will acquire the skills that will enable them to solve industrial problems while having a perspective on the underlying scientific issues.

Semester

S07

Programme

IDM-tc1: From Matter to Materials: Structure and Properties

IDM-tc2 : Practical work in Science and Engineering of Materials and Surfaces

Learning Outcomes

- To know the main families of materials with their specificity.
- To know the materials processes and Manufacture
- To know the mechanical constitutive laws of materials (elasticity, plasticity, fracture) as well as their physical properties.
- Be able to explain the relationships between processes, structures and mechanical properties.

Employment Sectors

Requirements

Crystallography (lattices, unit cells, Miller indices)

Thermodynamics (1st and 2nd principles)

Assesment

Final Mark = 70% IDM-tc1 mark + 30% IDM-tc2 mark

Option Website

Additional Information



DE LA MATIÈRE AUX MATÉRIAUX : STRUCTURE ET PROPRIÉTÉS

FROM MATTER TO MATERIALS: STRUCTURE AND PROPERTIES

Lecturers: Bruno BERTHEL

| Lecturers : 8.0 | TC : 32.0 | PW : 0.0 | Autonomy : 6 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

This module introduces a basis grounding on the materials currently used, on their structures and properties as well as the characterization methods. In particular, the approach used will underline the relation between the properties (mechanical and physical) and the structure of the material at a relevant scale. This knowledge will enable the student to propose well-considered selection of materials in relation to the elaboration and manufacturing processes for a given application. Practical work (IDM tc2) completes this teaching.

Keywords : Mechanical behaviour of materials (elasticity, plasticity, fracture, fatigue, creep), crystallography, heat treatment, metallic alloys, glasses, polymers, composites, solid state physics, electrical conductivity.

Programme

General introduction to materials engineering (2h Lec.) | Chapter 1: Materials: mechanical properties, structure (10h TC and 2h Aut.) : mechanical behavior on the macroscopic scale ; Interatomic bonds, structure and defects ; relation between mechanical properties and structure/defects. | Chapter 2: Families of materials: elaboration, modification of properties (2h lec., 14h TC and 2h Aut.) : Metals and metal alloys ; Polymers; Ceramics and inorganic glasses; Composites. | Chapter 3: Physical properties of materials (4h lec., 8h TC and 2h Aut.) : From Drude's model to Sommerfeld's free electron theory ; Nearly free electron model ; Electrical, thermal conductivity and magnetic properties of materials.

Learning outcomes

- To know the main families of materials and their specificity
- To know the materials processes and manufacture
- Be able to use the mechanical constitutive laws of materials (elasticity, plasticity, fracture)
- Know the physical properties of materials

Independent study

Objectifs : Acquisition and oral restitution of knowledge, situational exercises and problem-solving.

Méthodes : Personal and group work:
- Chapters 1 and 2: reading documents and doing exercises.
- Chapter 3: preparing an exercise and presentation during a tutorial

Core texts

J.-P. Baïlon et J.-M. Dorlot., *DES MATÉRIAUX*, Presses internationales polytechnique Montréal, 2002
M. Ashby et D. Jones. *MATÉRIAUX (TOMES 1 ET 2)*, Edition Dunod, 2008
C. Kittel *PHYSIQUE DE L'ÉTAT SOLIDE*, Edition Dunod, 2007

Assessment

Independent work and the acquisition of knowledge and skills will be assessed by means of "micro-tests" (continuous assessment)
Final mark = Knowledge mark = 90% exam mark + 10% continuous assessment mark



TRAVAUX PRATIQUES EN SCIENCE ET GÉNIE DES MATÉRIAUX ET DES SURFACES

PRACTICAL COURSES IN MATERIAL AND SURFACE SCIENCE

Lecturers: Bruno BERTHEL, Fabrice DASSENOY, Gaylord GUILLONNEAU, Michelle

| Lecturers : 0.0 | TC : 0.0 | PW : 32.0 | Autonomy : 12 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

The practical work of the IDM course provides the practical insight essential to the engineer's training and completes the notions developed in the course, relating to the three main families of construction materials: metals, polymers and ceramics. These practical exercises are grouped according to four themes: "Mechanical Behaviour of Materials", "Tribology and Surfaces", "Heat Treatment of Metal Alloys" and "Polymers and Composites".

Keywords : Mechanical behaviour of materials, tribology, heat treatment, metallic alloys, glasses, polymers and composites

Programme

Objectives (8h PW and 3h Aut. Per PW) : (i) Mechanical Behaviour of Materials: to introduce and practice the most commonly used tests to access the properties and mechanical behaviour materials. (ii) Tribology and Surfaces: to address, through a practical approach, some simple problems of wear and lubrication in a multidisciplinary framework combining mechanics, materials science and surfaces. (iii) Heat Treatment of Metal Alloys: to establish the relationships between chemical composition, heat treatment, microstructure and mechanical properties. (iv) Polymers and Composites: acquire knowledge of the processing of polymers and composites and then make the link between the process and the properties of the material.

Learning outcomes

- Know how to predict the mechanical properties of materials and their structures according to thermo-mechanical treatments
- Know how to identify the elaboration and treatment processes to adapt the properties of materials to a specification
- Know how to identify the relevant scale for a given property
- Be able to explain the basic principles of tribology (friction, wear, lubrication)

Independent study

Objectifs : Acquisition and oral restitution of knowledge, situational exercises and problem solving.

Méthodes : Personal and teamwork: reading documents, using databases, writing reports.

Core texts

J. Barralis, G. Maeder, *PRÉCIS DE MÉTALLURGIE*, Précis Afnor-Nathan, 2005
A. Dobraczinsky, M. Piperaud, J.-P. Trotignon, J. Verdu *PRÉCIS DE MATIÈRES PLASTIQUES*, Précis Afnor-Nathan, 2006
J.-P. Bailon et J.-M. Dorlot *DES MATÉRIAUX*, Presses internationales polytechnique Montréal, 2002

Assessment

The assesment takes into account punctuality, the work done during the session and the situation of the student with regard to a possible absence.

Final mark = Know-how mark = average of practical works maks